

TERRA

THE NATURAL HISTORY MUSEUM OF LOS ANGELES COUNTY

VOL. 22, NO. 1 • SEPTEMBER/OCTOBER 1983



FROM THE DIRECTOR



Dr. Craig C. Black

In the last issue of *TERRA* we announced that the Museum had been awarded a Challenge Grant from the National Endowment for the Humanities. The grant in the amount of \$750,000 is to be used in support of the Museum's many programs in the humanities. In notifying us of the grant, the National Endowment said, "...this was an excellent proposal...from an institution of national importance in the humanities." Later they asked to use the proposal as a model for others preparing grant requests to the Endowment because the Natural History Museum proposal was judged to be of exceptional quality.

Questions that often arise are "What are the humanities?" and "What are humanities programs in a natural history museum?" The humanities are those disciplines that are concerned with man, with our history, our thoughts, our enlightenment. They include history, philosophy, literature, criticism, classical studies, ethics, anthropology, and archaeology. In a natural history museum the humanities are generally thought of as being the responsibility of the archaeology or anthropology divisions. However, they are also very much a part of the education and exhibition departments where the historical and philosophical aspects of science should be a central concern. In Los Angeles the Natural History Museum also has a strong nationally recognized History Department. Overall the Museum devotes some 32 percent of its exhibit space to the humanities, and nearly 25 percent of its budgeted professional operation.

This month's issue of *TERRA* is largely devoted to research into human origins and an understanding of man's

place in nature. There is no topic more central to the humanities than that concerned with man's prehistory and the origins of social structure. Much of this work has centered in Africa and is reported upon here.

Museums of natural history today play a major role both in anthropology and in other disciplines of the humanities, in some instances performing research functions formerly the domain of our universities and colleges. Our Anthropology Department carries out studies and exhibitions on California and Southwestern prehistory and on North American, Pre-Columbian, African and Oceanic cultures. The Museum's History Division is concerned with studies relating to many aspects of California and Western history and with developing exhibitions and education programs for the public that explore and inform on all aspects of man's life in the New World.

Receipt of the National Endowment for the Humanities Challenge Grant will allow us to enhance our public programs in the Humanities for our diverse and growing public as well as to continue the scholarly research which is so essential to the growth of the Museum. Your support in meeting this challenge has been extremely gratifying. Over 600 members have responded to the challenge of raising matching funds to assure receipt of the federal grant. We will need the support of all our membership in this effort so that we may continue to warrant the accolade of "an institution of national importance in the humanities."

CURATORS @ COLLECTIONS

Membership Benefits Increase

Museum Members will now receive six issues of *TERRA* per year instead of four. With this first issue of Volume 22, the magazine becomes a bimonthly rather than a quarterly publication.

In addition, a new section—Two Months at Two Great Museums—will now appear in the center of each issue of *TERRA*. An exciting array of lectures, courses, and travel adventures offered through the Natural History Museum and Page Museum will be announced in advance to Museum Members in this new section, which replaces the monthly *CALENDAR*.

TERRA serves as a special set of exhibits by mail for Museum Members. Each

(Continued on page 29)

TERRA

THE MEMBERS' MAGAZINE
OF THE NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY
AND THE PAGE MUSEUM
OF LA BREA DISCOVERIES

VOL. 22, NO. 1 • SEPTEMBER/OCTOBER 1983



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Maori gateway figure, one of the largest carved figures known. From Rotorua. Height: 77 1/8 inches, early 19th century. Auckland Museum, New Zealand.

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Printed by North Hollywood Printing Co., Inc.

Color separations by Digital Dot

Typography by RSTypographics

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ISSN 0040-3733

TANGATA

THE MAORI VISION OF MANKIND



by DAVID SIMMONS

Photographs by Brian Brake

The beauty and dignity of New Zealand Maori carving in wood and stone will be highlighted in an exhibit at the Natural History Museum this fall. The exhibit features thirty-three photographs of Maori artifacts from museums and private collections in the South Pacific. In addition, many items from private collections in southern California will be on display. The artifacts from local collections, some of which are on public exhibition for the first time, give evidence of the scale and range of subject matter addressed by the Maori artists. The photographs dramatize the detail and integrity of the carving, which is regarded as the highest expression of Polynesian culture.

*Brian Brake, the featured photographer, is a New Zealander by birth, although he has worked in many parts of the world documenting the social conditions and artifacts of diverse cultures. His 1961 photo essay on India, *Monsoon*, was exhibited in the Museum of Modern Art in New York and won him the Award of Merit of the American Society of Magazine Photographers. A selection of Mr. Brake's photographs of Maori carving is presented here as a preview to the Tangata exhibit.*

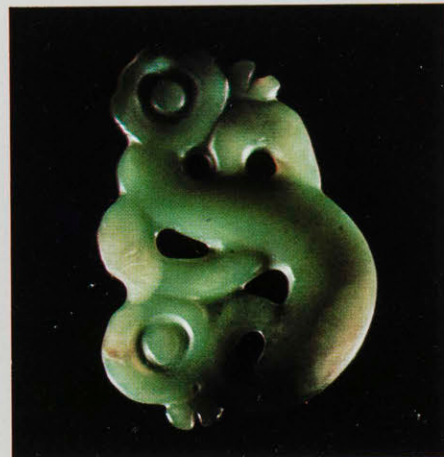
*David Simmons, Assistant Director and Ethnologist for the Auckland Institute and Museum, has provided the text for this article. Mr. Simmons is a leading authority on Polynesian art and culture; his many books and articles on the subject include *The Great New Zealand Myth and Art of the Pacific*, which he coauthored with Brian Brake and James McNeish. His comments here on the customs of the Maori peoples set the context for an appreciation of their art forms.*

*The exhibit *Tangata: The Maori Vision of Mankind* will be on view from September 13 to November 27, 1983. The photography portion is a New Zealand Government Exhibition sponsored in Los Angeles by the New Zealand Consulate General with support from Air New Zealand. Nancy Blomberg, Natural History Museum Anthropologist, has arranged for display of the objects from local collections.*

Top and bottom, left: House carving in an archaic Polynesian style. From Lake Tangonge near Kaitaia. Length: 88½ inches, c. 1200. Auckland Museum.

Center: Detail of a club from Northland, 16 inches, late 18th century. Auckland Museum.

Right: Greenstone ornament from Northland, 2⅝ inches, 18th century. Auckland Museum.



The Origin of Maori Tribes

The first settlers in New Zealand arrived about a thousand years ago from eastern Polynesia to find a land that was much colder than their tropical home yet rich in bird life. The sea produced fish and sea mammals, some familiar—like dolphins and whales—and others strange—such as seals and their relatives. The settlers' initial response was to use the bounty of Papatuanuku, the Earthmother, and her children, Tane of the forests and Tangaroa of the sea, and to live as sea people forever circumnavigating a rich and bountiful coast. Yet all things must change: population increased, and the round of natural succession was complicated by an ecology that included for the first time a large land animal, man.

A choice was made to control rather than exploit the environment. The introduced sweet potato became the main food source. Agricultural villages based on stored sweet potatoes led to competition for land, warfare, and migration to take over new territories. Thus were the Maori tribes born.

Professor Sydney Mead has characterized the changing social and art situation that followed:

The change from an East Polynesian type figure... to a Maori one probably coincides with a major change in cultural identity which is reflected not only in the art but also in the social organisation (canoe division) and in the use of canoe ancestors as reference points in reckoning genealogies. It is significant that genealogies not connected with canoe captains are largely ignored. It appears as though an entire cultural and historical heritage was denied and downgraded.

As to the reason for the social and political organisation one can speculate that the population movements and resettlement of the land south of Northland... upset the old mythological charter and made nonsense of traditional land claims through previous genealogical reference points. Thus, a new charter had to be devised (canoe traditions) and new genealogical reference points fixed (ancestors associated with founding canoe). In the process a new image and new identity were forged.

Detail of chief's ceremonial adze with greenstone blade. Length: 17 $\frac{3}{8}$ inches. Otago Museum.

Chiefs And Gods

Tribes often refer to themselves as a *waka* or canoe. When visiting tribes are greeted, they are often symbolically pulled onto the ceremonial greeting place (the *marae*) as if they were a canoe, with the cry, "Drag ashore the canoe, to the pillow the canoe, to the bed the canoe. To the resting place where will rest the canoe."

The *ariki* or paramount chief of the tribe is a direct descendant of the commander of the ancestor canoe and through him of the gods; therefore his person is sacred or *tapu*. As direct descendants of the gods, the *ariki* had the right to call on the gods for their goodwill in a tribal enterprise. The relationship with the gods was a practical one, with a bargain on both sides. The people undertaking the enterprise had to observe the courtesies and ask permission to use the bounty of the gods. They also had to employ all the skill they were capable of. This meant they would call on the tribal experts and the priest, the *tohunga*, who would direct the operation. With the goodwill of the gods, help from the ancestors and skill at working together, the enterprise would succeed.

The appeal to the gods was not in material items but by prayers, which at their simplest are charms like the one to bring rain: "Stands big sky, long sky.

The dark sky, the black sky, the intensely black sky like the bird. The sacred life force."

When the *tohunga* wished to speak to a god, he would place in the sacred place a symbol of that god, a god-stick. The god would then be asked to rest for a moment in his symbol so that the *tohunga* could talk to him. The symbol was not an idol but a *taumata atua*, a resting place of the god. Such symbols might also be placed afterwards near the work being done. The symbol would then remind the god that his aid has been invoked. If a tribal god allowed an enterprise to fail despite the efforts of the people, he would be invoked again. If the work again failed, a new god was sought.

Resting place of a god carved in volcanic stone. Found in Okato in 1905. Width: 22 $\frac{1}{2}$ inches. Taranaki Museum.



Storehouses And Meeting Houses

In the early nineteenth century, carvers began to focus their efforts on the chief's storehouse or *pataka*. These were not a new idea—small carved storehouses and weapon stores on a single pole had been used for a long time for storage. The new aspect was raising larger storehouses on piles.

Earlier, food stores were kept on the ground; but with the arrival of European ships came the black English rat and later the brown Norway rat. By the early 1820's, rats had become commonplace around most of the ship havens and in nearby areas, and it was probably these that caused the elevation of large storehouses onto piles.

Later, the carvers applied their skills to the meeting house of modern times, which evolved out of three pre-existing forms—the chief's dwelling house, the temporary guest house, and the halls and churches that the European missionaries had had the Maori tribes build.

Each meeting house symbolizes the gods and ancestors. It is named after an ancestor whose body it is. His head is the gable mask, his arms are the bargeboards, his backbone is the ridgepole, his ribs are the rafters and wall slabs. On the ridge pole in the porch are carved Rangi and Papa, the Earth and Sky, the first parents. Around the walls are all the ancestors of the tribe—warriors, gardeners, and learned men, all shown as warriors in whatever branch of life they excelled. Here too are the important female ancestors.

The ancestors around the wall are not just a history book of the tribe—they are in some way present as people, as part of the living tribe. The painted designs on the rafters of the house reflect the genealogy of the tribe, as do the ancestors on the walls. The best way to appreciate the carvings in a meeting house is to lie on a bed and look up at them—this is the way the carvers intended them to be seen. There is a feeling of great warmth when sleeping in such a house with all the ancestors and living people of the tribe.

The meeting house is a *whakauruuru hau*, a shelter from the wind, not just for the living and their children and grandchildren, but also for the ancestors.



A song of lament for the ancestors of ancient times:

What tender thoughts of you arise
My chieftain vanished in the night
Nought is left in my heart to cherish
But fond longing—fond and vain.
You are forever gone
And spirit voices breathe your name.
Here in this lonely world
I sit in dark despair
And mourn
With the sighing north wind.

Detail of a storehouse panel. Overall length: 36 inches, pre-1826. Taranaki Museum.



Detail of a house carving. Overall height: 42½ inches. The carving is a self-portrait of Raharuhi Rukupō, master carver of the house of Te Hau ki Turanga, carved at Manukū near Gisborne in 1842. New Zealand National Museum.

The War Canoe

In the nineteenth and twentieth centuries, Maori carvers have become known for their work on meeting houses. But in the eighteenth century, the prestige object for a tribe was the war canoe, and these were elaborately carved. War canoes were very *tapu* (sacred or restricted) objects dedicated to life and death. The warriors who used them had to undergo very careful purification ceremonies before entering the canoes and upon their return from an expedition.

The prow carving represents the separation of Rangi and Papa, the Earth and Sky, and carries on the front Tuma-tauenga, god of war, who warns Tangaroa, god of the sea, that men are passing over his domain. The stern of the canoe represents the life forces of man. The whole canoe is thus a statement about the origin of the world and the condition of man.

The only original war canoe still in existence is now in the Auckland Museum. It is a 90-foot canoe built from a single totara log with extra side board, a lattice-work prow and tall stern post. It was built at Wairoa, Hawkes Bay, in about 1836 by Ngati Kahungunu tribesmen; however, the carving was done by members of the Rongowhakaata tribe of Gisborne.

Death And Burial

A tribe is made up of two parts, the living members and the dead, who are ancestors. The world of the living is called Te Ao Marama, the world of light. On death, the spirit takes the path to Te Reinga, the northernmost tip of the North Island. There it dives into the sea to pass through the entrance into the other world, Te Po, the abode of the ancestors and gods. The ancestors of Te Po are always present looking after the welfare of their descendants. The recent dead sometimes have not finished making the passage into Te Po, so that when two tribes meet in ceremony they first greet the ancestors and greet and say farewell to the dead who accompany the living. Farewell, because the spirits of the recent dead are not to linger.

Although customs of burial have changed, the funeral or *tangi* remains relatively unchanged. For three days and nights after a death, the tribe and relatives sleep in the meeting house with the body. During this time, anyone who wishes to talk does so. The body is spoken to and told to cut its fleshly ties, and the relatives are made to recognize that the dead person has now changed his status from a living person to one who will soon take the journey to Te Po and become an ancestor.

In the northern area, it was the custom in the past to expose the dead on platforms within a sacred grove of trees. (In other areas, bodies were buried in a beach or trussed and placed in a cave for a time; in any case, the bodies remained exposed until the flesh had rotted and the bones were free.) Songs like the following were sung to remind the spirit that there was nothing left for him in the world of the living:

My sadness is that of a woman
From the pain
Soothe your skin
Reddened and blistered
That you may rest
Upon the pole
To amuse
Tipuhi's wife,
So that they can see
Your whitened skin,
Your melting face
Dripping down
To look at
Your rotting flesh
Your foul flesh
Full of liquid
To amuse Tipuhi's wife

(The spirit of the deceased was given no excuse to linger!)

The *hahunga* ceremony of cleaning the bones for great chiefs usually took place

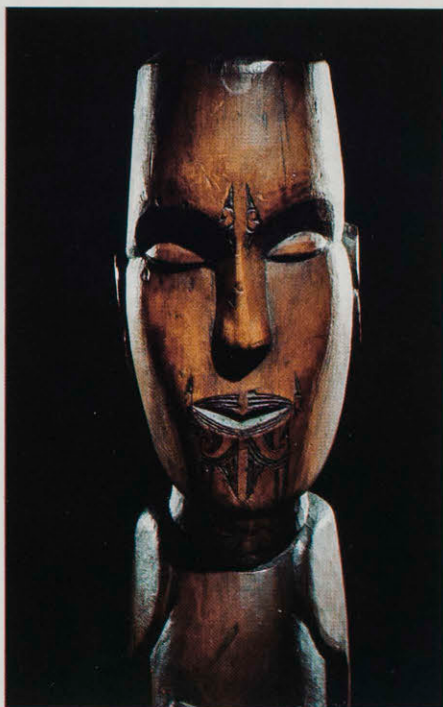


Above: Canoe prow from Long Beach, Otago, Height: 19 inches, 18th century. Auckland Museum.

Below: Detail of a canoe prow. Height: 59 inches, c. 1860. Auckland Museum.

about 2 months after death and lasted as long as several days depending on the importance of the dead person. With great ceremony, the remains were taken and wrapped in a new cloth. The whole was then decorated with feathers and ornaments. The chief who was the son or relative of the dead person took the bundle on his shoulders (the only time a chief carried anything on his *tapu* back) to a special place where old women covered with oil and red ochre and wearing wreaths of leaves on their heads received the body. The remaining flesh was buried, and the bones were cleaned and then painted with red ochre and tied in a bundle, which was placed in a burial chest carved to represent a mythological figure.

For ordinary people whose bones were placed in a cave without a burial chest, one great common ceremony would be held once a year. This is still held, even though bodies are now buried after death. Today the *hahunga* ceremony is the occasion when the tombs of the dead are concreted over and a tombstone put on them. Again this is the final farewell. The spirit of the dead person, if it has not cut its worldly ties before, is told in no uncertain terms to do it then.



Center pole figure, representing a female ancestor of high standing, from a small house at Taupo. Overall height: 32 inches, c. 1860. Otago Museum.



Left and below: Carved burial chest, depicting Hinenui Te Po, guardian of the underworld. The small figure between her legs is Maui, a culture hero who attempted to reverse the process of birth but failed. From the Bay of Islands. Length: 40⁷/₈ inches, 18th century or earlier. Auckland Museum.



Hei Tiki And Mana

The west coast of South Island is the only source of nephrite, or greenstone, which has always been a very precious and rare material to the Maori. In the late 18th century, the tribes in the northern South Island were able to extend their sway to cover the entire island and were thus able to control all the nephrite sources. One of the new items they began to export was the nephrite *hei tiki*. In the early 19th century, partly as a result of European demand for these "grotesque green idols," villages were established in southern South Island for the manufacture of the *hei tiki*.

Hei tiki and other objects made in greenstone are often given individual names by the Maori and are treasured as heirlooms. Each person who possesses one leaves some of his *mana* (prestige) with the stone. An heirloom of this worth will be welcomed onto a *marae* (ceremonial greeting place) as the physical symbol of all the ancestors who have possessed it. It will be cried over and addressed as though it were alive. When a person stands with such an heirloom around his neck or in his hand, then the *mana* of his ancestors is with him.



Hei tiki of jade, 18th century. Auckland Museum.

Stories of Early Times

The Arawa tribes that came to occupy the central volcanic plateau of North Island take their origins from the Arawa canoe, which landed on the Bay of Plenty coast some eighteen generations ago. When the Arawa canoe people arrived at their destination, Ngatoroirangi, their *tohunga*, went to explore the land southward. While there, he got caught in the snow of the hills and called on his sister to send fire from Hawaiki (the fabled original homeland of the Polynesian peoples). It came as a *taniwha* (monster), which surfaced at White Island, an active volcano out to sea in the Bay of Plenty. The *taniwha* went underground again and then surfaced at the volcanoes of Ruapehu, Ngauruhoe and Tongariro. The *taniwha*'s route marks the geological fault line.

The Ngati Porou, who live north of Gisborne, tell of their canoe, Horouta, which was built to sail to Hawaiki to get sweet potatoes. On the return voyage, the canoe was wrecked on a bar. The captain, Paoa, went inland to an area north of Gisborne to get a new bow piece. To get the bow back to the coast, Paoa urinated and said a charm:

Stretch forth water, stretch a long way
Descend as Motu this stream
Stretch forth water, stretch a long way
Descend as the Waipaoa, this stream
One stream went north to Opotiki and became the Motu River; the other flowed south to Gisborne as the Waipaoa River.



Left: Detail of a carved standing figure with sealing wax eyes. Overall height: 17 $\frac{7}{8}$ inches, early 19th century. New Zealand National Museum.

Above: Ceremonial fish hook pendant. Height: 2 $\frac{3}{4}$ inches, c. 1860. Auckland Museum.

Taranaki Mountain (known to Europeans as Mount Egmont) was originally one of the mountains standing in the central plateau near Tongariro Mountain. Taranaki fell in love with another mountain, Pihanga, the wife of Tongariro. Her husband was jealous and kicked Taranaki, who then decided to leave with his lover. Pihanga agreed to go, but she was annoyed with Taranaki for not standing up to Tongariro, so she decided to wait for awhile.

When Pihanga had gotten over her an-

noyance, daylight was breaking, and so she was fixed in place, for mountains can only move at night. Taranaki meanwhile had ploughed on down what is now part of the Wanganui River until he reached the end of the Pouakai Hills. There he stopped to rest, and he has been there ever since.

Taranaki is often wreathed in clouds—these are his tears for his loved one. Tongariro often erupts, showing his anger against Taranaki. The story of the three mountains is told in a traditional poem:

Tongariro stands apart
Taranaki is separated
By the strife over Pihanga
Hiding in later times
Its descendant in me.

Another poem was composed in the mid-19th century by Mere Ngamai to praise her mountain:

Enchanting to the eye
Art thou, O Taranaki
Clothed in snowy garment
O mountain gloriously arranged
In spotless cloak of gleaming white.
With fringe of patterned *taniko*
A robe of radiant beauty!

Yon cloud that wreathes thy lofty brow
Is a mourning chaplet,
Soft bank of kawakawa leaves
Emblem of sorrow for the dead,
Love circlet for the vanished ones
Forever lost to us.
Remain thou there, o peak of Rangi
Steadfastly keep thy silent watch
For ocean-borne grief messenger
For those who'll come no more.

Brian Brake to Speak at Annual Museum Members' Luncheon

Guest speaker for the Members' Luncheon this year will be internationally acclaimed photographer Brian Brake, whose color portraits of Maori art are featured in the exhibit *Tangata: The Maori Vision of Mankind*. Mr. Brake's talk will include an audio-visual presentation on Polynesian art forms in the collections of New Zealand's museums. Members attending the luncheon will also have an opportunity to view the *Tangata* exhibit, which includes many fine artifacts from private southern California collections, some on public display for the first time.

Join us for this special event on Monday, September 19th, at 11:30 a.m. at the Natural History Museum. The luncheon is \$15 per person; for reservations, call the Membership Office, 213/744-3426.

A F R I C A AND THE ORIGIN OF MAN

"It is... probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee, and as these two species are now man's earliest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere."

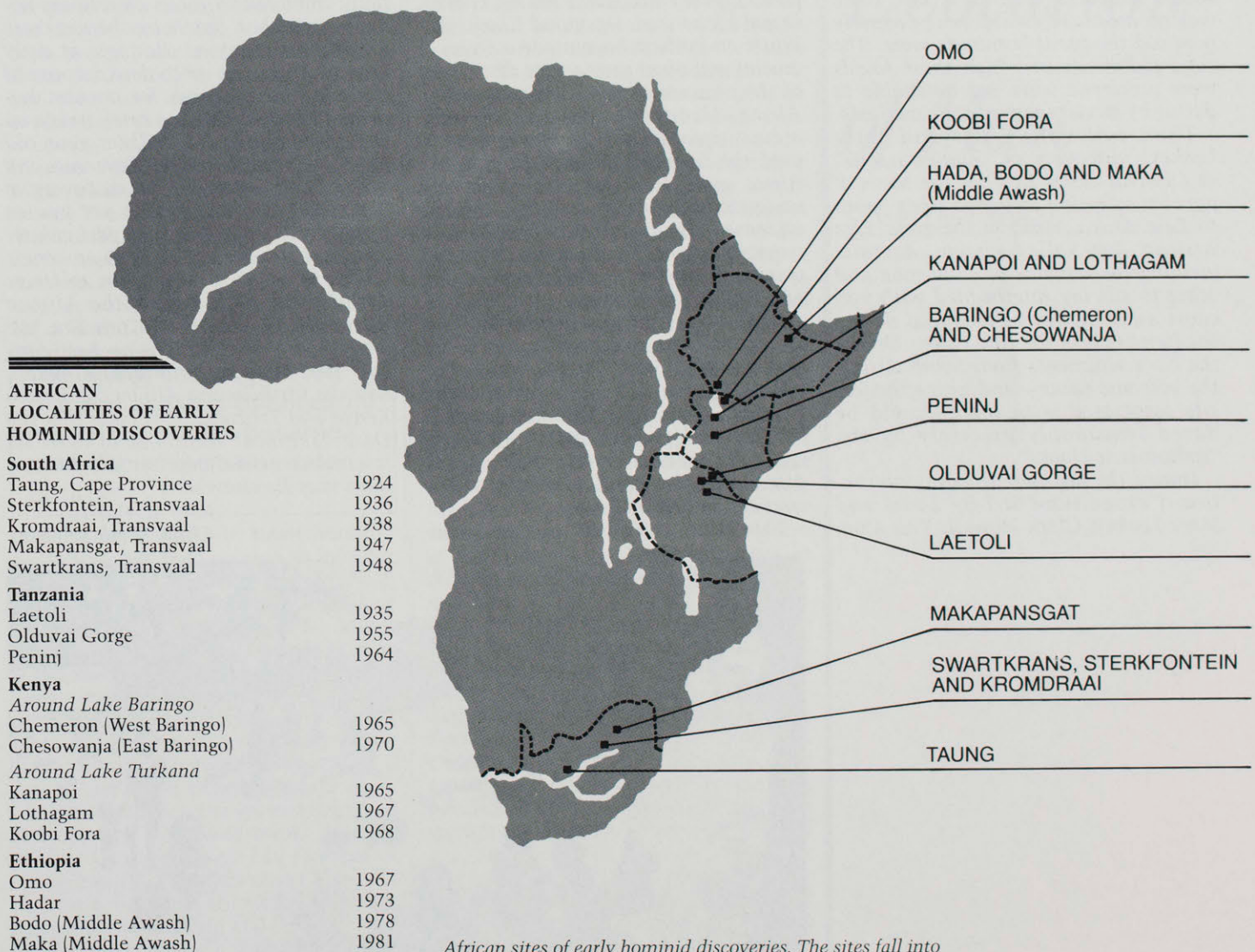
Charles Darwin's prophetic statement, written just over a hundred years ago, has been substantiated by many, often controversial, discoveries in southern and eastern Africa during the past sixty years.

The first truly ancient human fossil from Africa was reported from the cave

site of Taung, in South Africa, by Raymond Dart in 1925. This skull of a six-year-old child had human-like teeth but a small, chimpanzee-sized brain. It was thus almost the exact opposite of what learned European anatomists had predicted for the appearance of earliest man. Consequently it was several years

before the "Taung child" was generally accepted to belong to the Hominidae—the family of man.

Excitement mounted in the ensuing years as further examples of "fossil apemen" were discovered in South Africa. However, although they were found associated with other extinct animals



African sites of early hominid discoveries. The sites fall into two groups: those in southern Africa, found in dolomitic limestone caves; and those in East Africa occurring along the Great Rift Valley. Map and table after illustration in African Cradle of Mankind by P.V. Tobias (Ortina, volume 25 (1975), pages 24–35).

*"The Experiment that Failed": Australopithecus boisei. Painting by Jay Mat-
ternes from the collections
of the National Museum of
Kenya, Nairobi.*



which indicated their great age, there was no means of establishing precisely how old the fossil hominids were. The cave sediments in which these fossils were preserved were not amenable to dating by modern radiometric methods.

Thus, following Louis and Mary Leakey's discovery of "Zinjanthropus" at Olduvai Gorge in 1959, the focus of popular attention switched from South to East Africa. Here, in the great East African Rift Valley system, deposits yielding the remains of early man and other fossils lay interbedded with volcanic ashes and lavas produced during the formation of the Rift Valley. Unlike the cave sediments from South Africa, the volcanic rocks—and hence the fossils associated with them—could be dated reasonably precisely by the "radiometric clock."

During the last two decades, international expeditions led by Louis and Mary Leakey, Clark Howell, Yves Cop-

pens, Bryan Patterson, Richard Leakey, Donald Johanson, Desmond Clark, Tim White and others have made a series of crucial and often spectacular discoveries of the remains of early man in eastern Africa. Meanwhile, innovative techniques were devised in an attempt to date the hominid remains from South Africa more securely. As a result, our understanding of human evolution has increased significantly during the past twenty years while the timing of man's origins has been pushed back farther and farther into the past.

At least four different hominid species (many authorities recognize more) are now known to have lived in Africa during the interval of time between 1 and 4 million years ago. Although searches continue elsewhere, particularly in Asia, the overwhelming weight of evidence seems to point to Africa as the cradle of humanity.

This issue of TERRA was not origi-

nally intended to focus closely on human origins but, purely by chance, there are three articles on the topic of early man in Africa: an up-to date account of the continuing search for ancient humans in South Africa, a brief article on the now-famous 3.6 million year old footprints from Laetoli in Tanzania, and a first-hand report on the discovery of the oldest hominid fossils yet known from Ethiopia. We are also particularly fortunate to have in this issue an article on one of man's closest living relatives—the gorilla. What with the African theme of this summer's Craft Fair, the superb temporary exhibit on East African Mammals by Jonathan Kingdon, and the forthcoming Alliance Safari to Kenya and Tanzania, it is clear that the Dark Continent continues to exert its fascination even though our more recent roots may lie elsewhere!

John M. Harris
Chief, Earth Sciences



*Homo habilis. Detail from a
painting by Jay Matternes
from the collections of the
National Museum of Kenya,
Nairobi.*

Africa comprises almost a quarter of the earth's habitable land surface. It is the largest land mass to straddle the Equator, the Tropics and the Sub-Tropics. Indeed, close to three-quarters of its surface lies between the Tropics of Cancer and Capricorn. This immense warm area was the crucible within which there developed one of the great regional faunas of the world, and this province of the Animal Kingdom has been known since 1857 as the Ethiopian Faunal Region. The hominids (the zoological family of man) arose, according to the fossil record, within this Ethiopian fauna late in the Miocene or at the beginning of the Pliocene epoch, somewhere between 5 and 7 million years ago.

Fossils representing critical phases of awakening humanity have come from the tropical zone of eastern Africa (between latitudes 11° N and 3° S), mainly in the quarter of a century since 1959. In the last decade, much has been written, in both the popular and scientific press, about the formidable array of East African sites and hominids. These discoveries are associated with the names of Louis, Mary and Richard Leakey, Heselton Mukiri, Camille Arambourg, Kimoya Kimeu, Clark Howell, Brian Patterson, Yves Coppens, Donald Johanson, Maurice Taieb, M. G. Leakey, P. Nzube, B. Ngenyeo, H. Mutua, A. A. Mturi, and numbers of others.

From subtropical latitudes (between 24° S and 27½° S) of southern Africa,

The Taung find suggested that not all parts of ancestral hominids' bodies became man-like at the same rate or time.

another major series of fossil hominid discoveries has been coming to light for close on the last sixty years.

The earliest South African discovery was that of the Taung child skull, which came into the hands of Raymond Dart in November 1924. It was an epochal find from a number of points of view. At a time when Asia was enjoying the lion's share of attention as the probable cradle of the hominid family, Taung staked a compelling claim that Africa was more likely to have been the spawning ground of humanity. Dart's find awoke an echo of what Charles Darwin had foreseen in his 1871 work, "The Descent of Man." At that time, when the only fossil men that had come to light were a few Neandertals from Europe, Darwin had written: "It is... probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the Afri-

can continent than elsewhere."

This half-forgotten hypothesis was brilliantly verified over a half-century later with the discovery by Dart of what he called *Australopithecus africanus* at Taung in southern Africa. A staggering feature of the child fossil's skull was the small size of the brain case: it must have contained a brain no bigger than that of the great apes. Even when allowance was made for the youth of the Taung child, and an 'adult value' was worked out for its brain size, it was no greater than about 450 c.c., just one-third of the size of modern human brains. At a time when Dart's old teacher, Sir Grafton Elliot Smith, was arguing strongly for the primacy of brain enlargement in human evolution, Dart was holding in his hands a creature whose teeth were very human-like, the poise of whose skull on the spinal column was man-like, but whose brain showed little sign of the dramatic enlargement which has been the mark of later mankind. Instead of the brain's enlargement being in the vanguard, it seemed—from the evidence of the Taung child—to have been a late starter!

Yet, with the wisdom of hindsight, we now see that perhaps Dart's great contribution was that he compelled the world of anthropology to the realization that there had been, at one time, small-brained members of the family of man. A small brain alone is not sufficient to disqualify one from the exalted company of the hominids! Taung forced scientists to another realization, namely that not all parts of the ancestral hominids' bodies became man-like or hominized at the same rate or time. Thus, *Australopithecus africanus* had clearly begun to be hominized in its teeth, in the poise of the skull on the spine, in the form of the brain, in the inferred posture and gait—but it had not yet started the hominizing trend towards disproportionate enlargement of the brain. Such a pattern of development—of different parts at different rates and times—we call *mosaic evolution*.

So challenging were the questions posed by the little child of Taung that, initially, few scholars accepted the claim that it was something more than an unusual ape. One difficulty was that the first specimen had been the skull of a child: for it possessed all of its upper and lower milk teeth, as well as the first permanent molars. The latter teeth, in today's child, erupt at about 6 years of age. If the times of eruption were about the same in the Taung population, the child, with incompletely erupted first molars, might have been about 5 years of age when it died. The lack of most permanent teeth and the incompletely formed face and calvaria made it harder to predict what sort of individual such a child would have grown up into, had it lived longer. The finding of an adult was an absolute necessity.

South African Hominids and the Evolution of Man

by PHILLIP V. TOBIAS

It was 12 years later before Robert Broom, a remarkable medical man and paleontologist, found the first adult of a similar creature. It came from a site called Sterkfontein nearly 10 km (6 miles) north northwest of the little town of Krugersdorp, Transvaal, and about 50 km from Johannesburg. This cave site, like others in the vicinity, was formed as a result of karstic solution in pre-Cambrian limestone belonging to the Dolomitic Series of the Transvaal System of rocks. The main Sterkfontein fossil cave lies at an elevation of 1480 meters (about 4850 feet), and it overlies an extensive system of underground caves developed at an elevation of about 1450 meters. This site has proved to be the world's richest source of fossils of the species *Australopithecus africanus*, and the 'dig' that the Witwatersrand University has been conducting there constitutes the most sustained program of excavation made at any of the famous African early hominid sites. The cave therefore justifies a closer look.

Although it was not until 1936 that Broom found the first adult australopithecine fossil at Sterkfontein, it had been known since about 1896 that there were bone-bearing breccias (cave earths) in the cave. Even earlier than that, in 1884, two of the pioneering gold-seekers, the Struben brothers, had prospected on the farms containing the caves for seven months, but their work "disclosed nothing profitable." About 1898, some Marist Brothers from the first Johannesburg High School for boys visited the site on a donkey-cart and found a few fossils, which they reported in a French periodical called *Cosmos*. The crucial passage in their article (freely translated) reads, "In a certain place, a metre from the ground, I found animal fossils, a jaw complete with all its teeth. It must have been the jaw of a large antelope, probably the victim of carnivorous animals." During the next 40 years or so, sporadic visits were made to the caves and, in 1925, after the excitement generated by the Taung discovery, Dart was sent some fossils from Sterkfontein, including the skull of a large baboon. As the baboon skull appeared to Dart to be modern in form, he did not follow up the discovery at the time. In the early and middle 1930's, more fossils were collected at Sterkfontein, by students and staff members of Dart. These included James Gear in 1931 or 1932, Trevor Jones in 1935 and G. W. H. Schepers and Harding Le Riche in 1936. The fossil baboons collected by Jones, Schepers and Le Riche were given them by Mr. R. M. Cooper, who held the lime mining concession. It was a baboon endocranial cast, which Le Riche and Schepers took across to Broom in Pretoria, that led directly to Broom's first visit to the cave on August 9, 1936, and to his finding of the first adult australopithecine skull eight

days later.

The cranium confirmed for the adult what Dart had claimed for the child. Broom made many more discoveries at the site between 1936 and 1939, until the outbreak of World War II interrupted field operations.

It was during this period, too, that Broom obtained the first specimen of another kind of ape-man at Kromdraai, 1.6 km away. The new ape-man had bigger cheek teeth (premolars and molars) but curiously reduced front teeth (incisors and canines). Its bone structure was heavier and its muscular markings more pronounced than those of the fossils of Sterkfontein, although it agreed in possessing a small brain case. It is known today as *Australopithecus robustus*, and it has proved to be the first of an array of robust australopithecines ranging through an even larger-toothed form from Swartkrans, also close to Sterkfontein, to a gigantic-toothed form, *Australopithecus boisei*, from Olduvai Gorge in Tanzania and from sites in Kenya and Ethiopia.

Close study of these robust ape-men led paleoanthropologists to a startling conclusion. While it was not at all

Fossil finds in southern Africa yielded another revolutionary concept—that not all of the early hominids were ancestors of modern man.

difficult to envisage *A. africanus* of Sterkfontein as a probable ancestor of later forms of man in the genus *Homo*, *A. robustus* was a different matter. It showed too many of what paleontologists call specialized features to be on the lineage of *Homo*: these specialized acquisitions or *apomorphous* traits clearly seemed to be leading in a direction away from the main pathway of hominization. Moreover, the faunal evidence indicated that the two Transvaal sites bearing robust ape-men (Kromdraai and Swartkrans) were geologically more recent than Sterkfontein. Yet, on anatomical criteria, *A. robustus* was justifiably regarded as a hominid, no less than was *A. africanus*.

So, at the hands of Broom, southern Africa had yielded another revolutionary concept to the anthropologists, namely, the evidence that not all of the early hominids were ancestors of the later ones. Such a view was commonplace in studies of the ancestry of other mammals. Yet, in human studies, it had until that moment seldom, if ever, been realized that early hominids had diversified and formed new species by branching; nor that some of the branches—which were legitimately hominid—were not ancestral to later men of the genus *Homo*. Like Taung itself, that

realization proved a hard pill to swallow, and there are even today some scholars who would place all of the hominid fossils on a single lineage leading to modern man. For most, however, there is unequivocal evidence of the splitting of the ancient hominids into at least two lineages, and possibly more than two, only one of which went forward to give rise to *Homo* and ultimately to *Homo sapiens*.

To return to Sterkfontein: After World War II, Broom—pressed by Field-Marshal Jan Christiaan Smuts (himself an enthusiastic student of evolution and archaeology)—resumed work at Sterkfontein. He was 80 years of age, and he found a much-needed assistant in John Talbot Robinson. From 1947 to 1949, a number of new finds came to light including the splendidly preserved cranium of 'Mrs. Ples' (Sterkfontein hominid 5, found on April 18, 1947, less than three weeks after excavation was resumed).

Only five months after Mrs. Ples was found, another new australopithecine site came to light, when Makapansgat in the northern Transvaal yielded the first of a series of *A. africanus* fossils, in September 1947. Although it had been known since 1925 that Makapansgat was a fossil-bearing cave deposit, no serious work had been carried out there until, as a medical science student under Professor Dart, I led an expedition to the limeworks in 1945. On that memorable, all-student excursion, we recovered fossil baboons from the Makapansgat Limeworks of the same snub-nosed kinds as had previously been recovered from Taung and Sterkfontein. We realized then that we were on the trail of another *Australopithecus* cache. In January 1946, we recovered a large number of baboon and monkey skulls at the Limeworks, and my chief, Dart, accompanied me to the Limeworks in April 1946. Subsequently, he sent James Kitching and his two brothers and Alun R. Hughes to search the limeworkers' dumps for further primate remains. Seventeen months later, James Kitching found the first specimen of *A. africanus*, the back of a cranium, in September 1947—in the same unforgettable year in which Broom had found Mrs. Ples. The second specimen, a beautiful lower jaw with teeth of a youth of about 11 years of age (by modern standards of dental eruption), was found by Hughes, Schepers and Kitching in July 1948. A number of further specimens came to light at Makapansgat, and it became clear that, although there were some differences, the ape-man of Makapansgat were more closely related to those of Sterkfontein than to the robust specimens of Kromdraai and Swartkrans. Accordingly, both the Sterkfontein and the Makapansgat hominids have been classified as *A. af-*



Above: The Taung skull, historically perhaps the most important find of the century and anatomically one of the most perfectly complete early hominid skulls out of Africa. It comprises the face, lower jaw, teeth and superb endocranial cast of a child of perhaps 5 years of age. Professor Raymond A. Dart (center, left) recognized the importance of Africa's first australopithecine discovery, the Taung skull. This photograph was taken in early 1983 in Johannesburg at a banquet to commemorate Prof. Dart's 90th birthday.

Bottom, left: White lines in the pinkish breccia of Member 4 at Sterkfontein: these tell-tale marks are not streaks of limestone! They are parts of a hominid cranium, and two upper molar teeth can be seen near the lower index finger. This is how Specimen Stw 13 (at bottom, right) was first identified within Member 4—it turned out to be a fine face of an *Australopithecus africanus*.



ricanus transvaalensis, the type specimen from Taung being assigned to a different subspecies, *A. africanus africanus*.

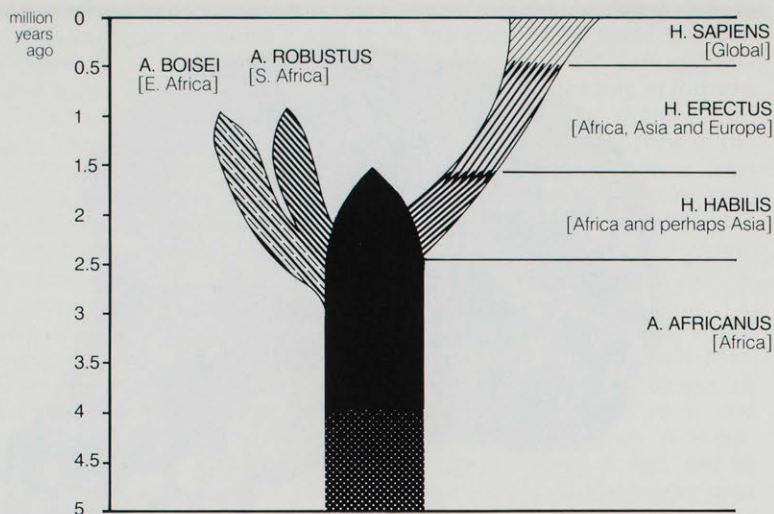
The following year, like 1947, proved an exciting one for discoveries in South Africa. Not only did Makapansgat produce in 1948 some nine specimens, including an all-important part of the hipbone, but in that year, too, Broom and Robinson shifted their attention from Sterkfontein to Swartkrans across the river valley. In November 1948, they obtained a fine mandible with teeth and some isolated upper teeth of an adolescent with still bigger premolars and molars than those of Kromdraai. If Kromdraai had revealed the diversity of the early Transvaal hominids, Swartkrans added a new dimension to the picture; for these ape-men were even more robust than those of Kromdraai. For the first time a panorama of early hominid variability was emerging. Swartkrans has proved to be the single richest site of early hominid remains in the world. From that one relatively small cave deposit have been found fossils of no fewer than a hundred individuals of *A. robustus*. Some of my colleagues believe the differences between the Swartkrans ape-man and those of Kromdraai are such as to justify calling them separate species; others regard them as members of different subspecies.

In 1949, work was proceeding on three fronts in South Africa: Broom and Robinson closed down their operations at Sterkfontein, but not before another two dozen hominid specimens had been chalked up on the site tally. At Makapansgat, Hughes obtained another five specimens. Switching their attention from Sterkfontein to Swartkrans, Robinson and Broom almost immediately uncovered a veritable avalanche of crania, mandibles, teeth and postcranial bones. Most important, 1949 provided the first evidence of two different kinds of hominid in the same stratum at one site, when Robinson found that, along with *A. robustus*, Swartkrans held remains of a more advanced kind of hominid which we recognize today as being unmistakably *Homo*. At least some of the parts assigned to this group were found in the same layer as contained *A. robustus*. After Broom's death in 1951, Robinson found several more fossils attributable to the same advanced group.

About this time, studies by Basil Cooke, R. F. Ewer and L. H. Wells were beginning to suggest that, of the four Transvaal sites containing *Australopithecus*, Makapansgat was the oldest, Sterkfontein not quite as old, and Swartkrans and Kromdraai somewhat younger, geologically speaking. It was beginning to seem that the older sites contained the more lightly constructed *A. africanus* and the more recent sites the robust australopithecines. In those



Cranium of *A. robustus* from Swartkrans, Transvaal. The crest on top of this skull, of which a part is preserved on this specimen, marks the limit of the very large masticatory muscle responsible for lifting the lower jaw. If the mandible is very big, then the muscles attaching it to the cranium are likewise well developed, and on a small brain case they may reach the middle line—as in this robust ape-man.



A family tree of the hominids over the past 4 million years based on world-wide fossil data and dating evidence. East African specimens that have been dubbed "*A. afarensis*" are considered by me to be members of *A. africanus*.

years, too, the meticulous anatomical studies of Sir Wilfrid Le Gros Clark of Oxford on the South African fossils were showing unequivocally that all of the australopithecines should be classified in the family Hominidae: they were the small-brained hominids, some of which seemed to be excellent claimants to have been the ancestors of *Homo*. The subject was beginning to acquire the lineaments of a carefully controlled scientific investigation.

In 1954 Charles K. Brain undertook some investigations on the geological background of the ape-men. During the course of these studies, which embraced all four of the Transvaal sites, Brain found stone implements in an upper breccia of the Sterkfontein deposit in 1956. This exciting find led Robinson to return to Sterkfontein from Swartkrans, and so began the third phase in the investigation of the Sterkfontein hominid site (1957–58). A volume of the artifact-bearing breccia was excavated and, apart from the implements, some fragmentary hominid remains were found in the upper part of the deposit. Since they were associated with the artifacts in the same breccia, it seemed reasonable to infer that they represented the tool-maker of Sterkfontein. But they were so inadequate and nondescript that it could not be determined exactly what species or form of hominid those bits and pieces represented. For a long time, the identity of the Sterkfontein tool-maker remained a mystery.

From 1958 to 1965, relatively little work was carried out in South Africa: Robinson had left for the United States, and in 1959 I had succeeded Dart as chairman of the Department of Anatomy at the University of Witwatersrand Medical School. Moreover, my own energies

had been drawn away by Louis and Mary Leakey who had persuaded me to undertake the definitive study and evaluation of all the hominid specimens they were exhuming from the Olduvai Gorge in Tanzania.

In the middle 1960's, Brain—who had succeeded to the directorship of the Transvaal Museum, Pretoria—began a new excavation at Swartkrans. The following year, 1966, as part of the commemoration of the centenary of the birth of Dr. Robert Broom, Hughes and I started a new dig at Sterkfontein. These activities have continued ever since. We have been joined by Tim Partridge, a geomorphologist of Johannesburg, who has worked out in great detail over more than a dozen years the stratigraphic sequences of the Transvaal sites. His work and that of Karl Butzer of Chicago have yielded a clearer picture of the dating of these sites. Numbers of colleagues from abroad and southern Africa have joined in the examination of the faunal remains associated with the hominids, as well as in that of the hominids themselves. Moreover, the wealth of material now reposing in the Anatomy Department of Wits University, Johannesburg, and in the Transvaal Museum, Pretoria, has attracted research students from the United States, Canada and England as well as southern Africa. Numbers of these have found sufficient material so that each could devote a doctoral dissertation to one region of the body, e.g., the wrist, hand and finger bones; the hip and thigh bones in relation to uprightness and bipedal locomotion; the structure of the permanent and deciduous teeth; the use of the masticatory apparatus; the ankle and foot bones; the cranium.

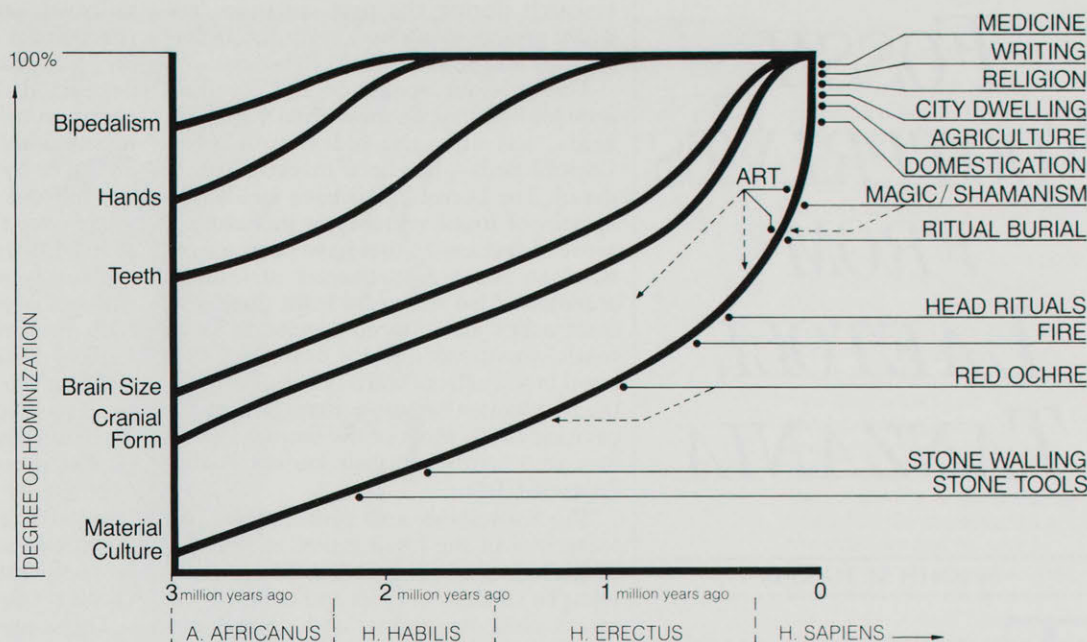
Since we resumed our excavations at

Sterkfontein at the end of 1966, we have recovered nearly another 200 hominid specimens, to add to the appreciable stockpile available previously. In addition, we have found several thousand baboon and monkey specimens, quantities of antelopes, as well as some representatives of other groups, such as the pig family, hyaenas and other carnivores, innumerable rodents (derived from owl pellet breccia) and some insectivores, rabbits, birds and other animals.

There is evidence in both East and southern Africa for the appearance of tool makers about 2 million years ago.

We now know that there are six distinct strata or members in the 'Sterkfontein Formation,' numbered from below upward. In Member 4, we have the rich repository of *A. africanus* but no stone tools. Above it, in Member 5, we have remains of more recent fauna, no signs of *A. africanus*, indicators of a drier climate than that prevailing in Member 4 times—and the presence of the enigmatic stone tools. In 1975 we uncovered the identity of the tool-maker, when Alun Hughes discovered in the tool-bearing Member 5 a human skull (Stw 53) different in many respects from *A. africanus*. Its nearest affinities are with the type of early *Homo* skull from East Africa to which, in 1964, L. S. B. Leakey, John Napier and I gave the name of *Homo habilis*—or "handyman." It appears that *Homo habilis*—or something very similar to it—was responsible for the stone tool-making activities at Sterkfontein.

A diagram representing humanity's mosaic pattern of evolution. The graphs of development approach the top line—representing 100 percent hominization, or the attainment of modern human structure—at varying rates and times. The bottom curve shows the pathway of cultural evolution. From left to right, the hominids travel through four species grades and 3 million years up to *Homo sapiens* of the present.



From careful comparisons of the fauna with the East African faunas, Elisabeth Vrba has concluded that the members at Makapansgat containing *A. africanus* are about 3 million years before the present, the same date to which paleomagnetic data from the site have led. On the newest evidence on the dating of the Hadar site in northeast Ethiopia (where 'Lucy' and the 'First Family' and other well-known fossils were found), it seems that Hadar and Makapansgat Member 3 were of approximately the same age. The Sterkfontein member containing *A. africanus* has not yet been dated by paleomagnetism, but its faunal remains bespeak an age of perhaps a few hundreds of thousands of years younger than the corresponding level at Makapansgat—of the order of 2.75 million years. On the other hand, the fauna in Sterkfontein Member 5—with the stone tools and *H. habilis*—suggests an age of about 2 million years. There is an unconformity between the preserved part of the top Member 4 and the bottom of Member 5, and this would account for the elision of some three-quarters of a million years (between 2.75 and 2.0 million years) from the Sterkfontein sequence. Within that lapse of time, the tool-makers seem to have appeared on the South African scene. It is interesting that the East African sequence also shows the appearance of tool-making hominids about 2.0 to 2.3 million years ago, at the end of the Pliocene; a few claims for earlier-worked stone material have not been corroborated.

Both at Makapansgat and at Sterkfontein, there are members in the respective formations that lie deeper to the deepest horizon in which hominids have been found. A great depth of members 3 and 2 at Sterkfontein is known to be fossil-

bearing, and it is likely that hominids will be found there before long. With unconformities between successive members, it is probable that these lowermost hominids will be of an age appreciably greater than 3.0 million years and thus closer in time to Mary Leakey's famous footprint site of Laetoli in Tanzania, which has been dated between 3.59 and 3.77 million years. Similarly, at Makapansgat, Members 1 and 2 are fossil-bearing, and we are hopeful that earlier hominids than those in the well-known 'grey breccia' of Member 3 dated to about 3.0 million years will come to light, taking us further into the Pliocene.

Meantime, Brain's intensive research at Swartkrans and a new excavation by E. Vrba at Kromdraai have revealed more about the stratigraphy at both of these sites. It is now clear that all four of the Transvaal sites contain within their deposits a sequence of strata or members, each of which is separated from the subjacent and superjacent layers by time-lapses. These are often of such duration as to have permitted substantial changes in the fauna, including the hominids, to be sampled in successive members. Such a situation is of immense value for the student of evolution: it is beautifully exemplified by the contents of Members 4 and 5 at Sterkfontein and of Members 1 and 2 of Swartkrans.

This concept of the dolomitic limestone cave deposits is an essentially new one, and we knew nothing of this possibility when we started the presently ongoing programs of work in the mid-1960's. From many points of view this understanding has enhanced the value of each of the cave deposits: instead of a virtually continuous sequence of deposition, as in most archaeological

cave fillings, we have in effect five or six different cave deposits in such a sequence as that of Sterkfontein. The contents of each of these deposits can be analyzed to give a picture of life of that period; then we have the opportunity of studying the sequence of populations through the members. Withal, conditions of preservation within the caves are generally excellent; thus we have numbers of relatively intact skulls and, too, we have the only goodly sample of natural endocranial casts such as those of Taung, Sterkfontein and Swartkrans.

While these are the advantages of the cave deposits in southern Africa, the big disadvantage is the hardness of the calcified cave earth and the necessary slow rate of progress.

Thus, South African cave deposits and their contents nicely complement the East African sites, which are open sedimentary deposits laid down on the banks of streams and lakes. Deposition under the latter conditions also has its pros and cons. Between these two major zones of Africa, the world has been furnished with fossilized skeletal and dental remains of not fewer than 500 hominid individuals and possibly as many as 600. These remains represent males and females of various ages, and at least four to six different species. They are spread over a period dated from about 5 to 1 million years before the present.

Collectively, they provide compelling evidence that man's family has evolved and diversified and that the major nascent steps in the coming of humankind were taken in Africa.

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FOSSIL FOOTPRINTS FROM LAETOLI, TANZANIA

by JOHN M. HARRIS

The Serengeti Plain of northern Tanzania is famous for the abundance of its wildlife and, in particular, for the annual migration of teeming herds of wildebeest—a spectacle that draws tourists from all over the world. The Serengeti is also justly famous for its contribution to human evolution. A few miles west of Ngorongoro Crater lies the site of Olduvai Gorge from which Louis and Mary Leakey and their associates have recovered human fossils and artifacts that date back nearly two million years.

Between three and four million years ago, the peace of the Serengeti was shattered periodically by the eruption of Sadiman Volcano. Sequential pulses of volcanic ash mantled the countryside, covering over the carcasses left by Pliocene scavengers and burying alive rodents, hares and aardvarks in their burrows. Footprints left in the ash by animals crossing the area now known as Laetoli, located some 30 miles south of Olduvai Gorge, were buried by ash from subsequent eruptions and were thus preserved for posterity. Discovered in 1976, these footprints provide a record of the animals that inhabited the Serengeti during the Late Pliocene epoch and document some aspects of their behavior. The more than 50,000 tracks and trails include footprints left by our earliest ancestors.

The Pliocene site of Laetoli—one of the most interesting yet discovered in East Africa—takes its name from the Maasai word for the red lily (*Scadoxus multiflorus*), which grows throughout the region. Although the presence of fossils at Laetoli has been documented for nearly 50 years, it was only recently, when a field party working under the direction of Dr. Mary Leakey recovered fossil human material in 1974, that the importance of this locality began to be fully appreciated. Further field work and

research during the past six years has added greatly to our understanding of the geology and paleontology of the area.

The geologic sequence at Laetoli is now known to span more than 4 million years, but only the oldest unit—the Laetoli Beds—has been investigated in detail. The Laetoli Beds have yielded 80 species of fossil vertebrates including a score of specimens that have been attributed to *Australopithecus africanus afarensis*. Also recovered from these ancient ashes are a dozen species of land snails, fossilized termite nests and the fossil brood cells of solitary bees. But it is the footprints that are, perhaps, the most exciting finds. Most of the footprints occur in a single ash unit known as the Footprint Tuff.

The formation and preservation of footprints in the fossil record requires a special set of circumstances. The ground must be sufficiently soft and cohesive to retain clear footprints, and these footprints must be rapidly buried by more sediment before they are destroyed by the effects of weathering and erosion. The fine-grained ash particles of the Footprint Tuff preserve clear prints of both small and large animals. The ash layers must have been firm at a shallow depth beneath the surface because most of the largest (elephant and rhino) prints are less than two inches deep; tracks left by modern elephants in the blackcotton soil of Laetoli are often more than two feet deep!

The Footprint Tuff was deposited about 3.6 million years ago from a series of short-lived eruptions that took place over a period of between several weeks and several months. The tuff is up to six inches thick and can be divided into two units. The lower unit, usually about 2.5 inches thick, consists of 14 separate layers, each of which represents a single



Fossil Guinea fowl footprints on a surface pitted by fossil raindrop impressions. Photo: Peter Jones.

volcanic eruption and may be traced throughout the entire 27 square mile area in which the Footprint Tuff was deposited. Rain printed surfaces are common at five horizons; the rain drop impressions are close together and were produced by showers that dampened the ash but did not erode it. Footprints are found over the top of the lower unit and at five horizons within it.

The upper unit of the Footprint Tuff consists of four widespread layers, again each the product of a single eruption. Each of these four layers has been extensively reworked by water—probably the sheetwash associated with heavy showers. Footprints are common on the lower two of these layers. The upper unit is overlain by a coarse tuff composed of lava particles and crystals of the minerals augite and biotite; the layer represents the culmination of this particular eruptive sequence of Sadiman volcano.

The study of the animal and plant fossils from the Laetoli Beds indicates that at the time these beds were deposited, the climate of the northern Serengeti was not very different from that of the area today. The low-lying countryside was covered by grassland interspersed with *Acacia* woodland. The annual rainfall, probably as today deposited in the course of a single rainy season, was in the order of 25–40 inches. The depositional sequence of the Footprint Tuff has been studied in minute detail by Dr. Richard L. Hay of the University of California at Berkeley. Dr. Hay believes that the horizons of rain prints in the lower unit were produced by short-lived showers near the end of the dry season. The upper unit was deposited during an interval of heavier rain, presumably the onset of the rainy season. The footprints preserved in the lower unit are chiefly of hares, guinea fowl, rhinoceros and other animals whose descendants today remain in the grassland savanna during the dry season. Footprints from the upper unit include a greater number of large antelope footprints and also those of extinct species of elephant, zebras, baboons and man, none of which occur in the lower unit. These probably record the rainy season migration, a feature characteristic of the East African savanna today.

An exhibit featuring casts of some of the Laetoli footprints, including a short portion of the hominid trails, is currently on display in the African Mammal Hall.

Dr. John M. Harris is the Chief Curator of the Museum's Division of Earth Sciences. With Dr. Mary Leakey, he has recently completed the compilation of an extensive monograph on the geology, fossils and footprints from Laetoli featuring articles written by more than 30 contributors. The monograph has been submitted to University of California Press for publication at the end of next year.

The trails left by three fossil hominids were discovered at Footprint Site G in 1978. One trail consists of 37 prints of a small individual, perhaps a female, standing just over four feet tall. A second trail of 31 prints was made by two individuals, one walking in the footsteps of the other. Only the prints of the second person in the trail could be measured but were probably about four feet seven inches tall and could have been a male.

Fossil hominid jaws and teeth have been recovered from Laetoli and have been attributed to the species *Australopithecus afarensis*. Fossil hominids of similar age from Hadar in Ethiopia have been attributed to the same species. Both the hominid limb bones from Hadar and the footprints from Laetoli belonged to creatures that were fully capable of upright bipedal locomotion. However, the hominid toe bones from Hadar are curved. At least one paleoanthropologist believes that the human species that made the Laetoli footprints



did not have curved toe bones like the Hadar specimens.

Three trails left by the three-toed horse *Hipparion* were found next to the hominid trails but travelling in the opposite direction. Two of the trails were of adult hipparions, the third was of a foal. Modern horses have only one functional toe on each foot. Study of the hipparion trails indicates that the animals were travelling about 6–8 miles per hour in a single foot (fast walk) gait. Most of the Laetoli hipparion prints show the impression of only the central toe but where the trail of the foal crosses that of one adult the impressions of the side toes can be seen in the adult trail. It would seem that when the path of the adult was crossed by the foal, the adult hipparion extended its side toes to maintain its balance on the slippery ground surface without having to reduce its speed. Photo: John Reader.

Exposures of the Laetoli Beds. The flat surface is Tuff 7—the Footprint Tuff. Photo: Peter Jones.



Trail of elephant footprints at Footprint Site D. These prints were presumably made by the ancestral African elephant (*Loxodonta exoptata*), the bones and teeth of which are found elsewhere in the Laetoli Beds. The small prints pitting the surface were made by either an extinct hare (*Serengetilagus praecapensis*) or an extinct dik dik (*Madoqua avifluminis*). Photo: Peter Jones.

It happened unexpectedly a week before we broke camp. We had spent three months in the fall of 1981 scouring the ancient rocks in the badlands near the Awash River in Ethiopia. We had found them thick with bones: skulls and partial skeletons of fossil elephants, hippos and pigs; jaws and teeth of species of fossil antelope, rhinos, horses, hyaenas, monkeys, shrews and rodents; shells of fossil turtles, and the petrified eggs of crocodiles. These animals had lived between one and five million years ago, during the Pliocene and Pleistocene Epochs of the earth's geologic history. Some of their modern descendants now lived in the same badlands and along the floodplain of the Awash River. Daily, these animals traversed the Plio-Pleistocene rocks that preserved the bones of their ancestors and their extinct evolutionary relatives. So did we. In one of the badland coulees, near the remains of a fossil pig, we found pieces of the skull of a fossil "ape-man" or, more properly, a hominid. As we were to find out months later, the bones were the oldest known remains of early man.

Our expedition to the Middle Awash District was grounded in history. The Awash badlands lie in the East African Rift, where plate tectonics has ruptured the earth's crust from Tanzania in the south to the Gulf of Aden and the Red Sea in the north, and exposed the ancient rocks that preserve part of the history of human evolution. The Rift is dotted by famous early man sites: Olduvai Gorge and Laetoli in Tanzania; Koobi Fora in Kenya; Omo and Hadar in Ethiopia. These sites have yielded the best record of fossil hominids: three species of *Australopithecus* (*A. afarensis*, *A. africanus*, *A. robustus*) and two species of *Homo*

We found pieces of the skull of a hominid in one of the coulees. Months later we learned the bones were the oldest known remains of early man.

(*H. habilis*, *H. erectus*), the genus of modern man. One of the most famous discoveries occurred in 1974 when Donald Johanson and a team of American and French scientists recovered a wealth of hominid material—including the partial skeleton of "Lucy"—from Pliocene rocks at Hadar, just north of the Middle Awash.

The success of Johanson's work at Hadar brought us to the Middle Awash in search of hominids and the Plio-Pleistocene faunas that had evolved alongside early man in the same ancient environments. The expedition was multidisciplinary. It was led by Drs. Desmond Clark and Tim White, anthropologists at the

BONES FROM AFAR, OLDEST "APE MAN" FROM ETHIOPIA

by LEONARD KRISHTALKA



At Bodo, Tim White examines a collection of Acheulean stone tools and the core from which some of them were flaked.

University of California, Berkeley, and included archaeologists, geologists and paleontologists. Our base camp was at Bodo, the local Afar name for one of the many dry streams that run from the volcanic highlands in the east through the badlands of Plio-Pleistocene sediments and over the floodplain to the Awash River. Bodo means depression in Afar, a likely reference to both the local topography and the mood that the 110 degree heat can instill. Camp consisted of large, green tents, a mess area, storage tents, and a "laboratory" area under a white canvas fly. The open-air kitchen, where pots and pans hung from acacia trees, was omitted by the Michelin Restaurant Guide. But one of the cooks, Kabete, produced fine pasta and roast goat dinners over open fires. And Haddis, the other cook, used his accomplished baking talents and a makeshift oven (a hollowed-out termite mound) to serve up fresh bread daily. Accompanying us in camp and in the field were representatives of several Ethiopian government ministries, Afar guides, and armed Afar guards who were on the watch for game poachers and rival tribesmen. Most of our supplies came from Addis Ababa, the capital of Ethiopia about 250 miles to the south and west, but some foodstuffs were available in Gewane, a small Afar village that was a four to five hour drive away over a dirt track. Good water was a

Friends wrote that they were green with envy; we were green with dysentery.

precious commodity. At first we managed to tap the groundwater of the Bodo stream for the 75 to 100 gallons we needed each day. But as the Ethiopian dry season continued, the flow of groundwater diminished to a trickle of dissolved salts and minerals that played havoc with our intestines. When friends wrote letters saying that they were green with envy over our work in Ethiopia, little did they know that we were green with dysentery. From then on we hauled water from the Awash River and used alum and purifying tablets to settle the sediment and kill the bacteria.

The badlands in the Bodo area were rich in fossils and provided the first telltale signs of hominids. Strewn among the geologically younger rocks were Acheulean-type stone hand axes and choppers that hominids, probably *Homo erectus*, had fashioned, used and discarded. Nearby stood the stone boulders, or cores, from which the tools had been flaked. From the same sediments had also eroded skulls, jaws, teeth and skeletal bones of contemporaneous Pleistocene mammals—pigs, hippos, and a variety of antelope. At some of the

localities Desmond Clark and the other archaeologists—Jack Harris, Hiro Kurashina, and several graduate students—opened gridded excavations, pits and trenches in the hope of finding *in situ* associations of stone tools and animal bones and, perhaps, a “living floor” of early hominid activity.

A few of the researchers, especially Tim White, Bob Walter, a geophysicist at the University of Toronto, and I, made four and five day forays to survey areas south and west of Bodo—Matabaietu, Sibabi, Wee-ee, Maka, and others—where many of the rocks were older than at Bodo and held the promise of significant discoveries. We were hoping to find hominids and other fossil animals that were older than “Lucy,” which was originally dated at about 3.6 million years. In each area the work was the same. The badland exposures were prospected for the remains of the fossil faunas, which were photographed and tied to the particular rock bed from which they had eroded. The geologic strata were traced, mapped and correlated from area to area to document each sequence of rocks and the stratigraphic position of fossil-producing localities. Thin bands of white and gray volcanic tuffs—the ashfalls from past volcanic eruptions—lay compressed between many of the rock strata. In the mineral crystals of the ash ticks a radioactive clock that can be read with precision in the laboratory and can tell us the absolute age of the rocks. Bob Walter removed a load of samples from these tuffs in each area for dating at Toronto.

This multifaceted approach is necessary to reconstruct the picture of hominid evolution. Hominid bones and teeth tell us only about the anatomy and physical adaptations of early man. A knowledge of the evolution of the other species of fossil animals—elephants, pigs, hippos, rhinos, antelope, rodents, and others—over the last five million years can provide clues to understanding the environmental factors behind the causes and course of hominid evolution. During the Plio-Pleistocene some species in each group of animals went extinct. Others did not, but underwent a gradual change in anatomy that implies the survival of successful variants in a changing environment. Much of the anatomical change occurred in the dentition, indicating a changing diet between successive species, and, by implication, particular changes in vegetation, climate and terrain through time. The same environmental changes affected hominid evolution. Of course, to paleontologists like John Harris of the Natural History Museum and myself, the evolution of the African faunas is, in itself, as exciting and important a field of investigation as is that of early man. The fossil record of these animals is our best avenue toward understanding the biology, zoogeography

and evolutionary dynamics of the African life of the past. A third area of importance of the fossil Plio-Pleistocene faunas is in correlating rock layers from disparate areas; this is crucial in instances where rocks cannot be dated radiometrically. The working principle behind faunal correlation is simple: rock layers in different geographic areas are approximately the same age if they preserve many of the same species of animals. This has proven especially useful in East Africa, where some of the hominid sites are geographically distant from one another and cannot be dated chemically. Specifically, work by John Harris, Tim White, and Basil Cooke, of Dalhousie University, established the evolution and succession of species of fossil pigs as a reliable yardstick for correlating the East African Plio-Pleistocene rocks. These three facets—the

sequences of rocks, fossil animals, and dated volcanic tuffs—are intertwined. Together they document the chronology and character of hominid, faunal and environmental evolution.

Three of the badland areas in the Middle Awash proved to be extraordinarily rich in fossil remains, especially of mammals. In many of the valleys at Wee-ee, Maka and Belohdelie—successive drainage areas south of Bodo—lay the bones of Pliocene bestiaries: a monkey jaw near the skull of a pig; elephant teeth, of both juveniles and adults, alongside fractured hippo skulls; jaws of a rhinoceros and the extinct Pliocene horse *Hipparion*; horn cores and partial skulls of many African antelope; here a fossil rodent, there the exploded remnants of a turtle shell; bullet-like crocodile teeth, and nests of petrified eggs. Where the remains had only recently eroded, the skeletons and



Dr. White prospects the Plio-Pleistocene badlands in the Gamedah area of the Middle Awash.



Aramis, an Afar village on the west side of the Awash River.

skulls were nearly intact. In other instances, the scattered teeth and bits of bone were all that remained of fossils that had long since become exposed and been weathered to dust. Much of the success in finding these fossils involves luck and perseverance, although experience improves the odds. Repeated passes through a valley revealed bones that had been previously overlooked. Often, fossils in plain sight can be camouflaged by shadows, poor light, and the blending of the colors of the earth and the petrified bone.

The geology of these areas was no less variable. Where the strata were undisturbed, they lay flat, one on top of the other, in the same sequence in which they had been deposited—oldest on the bottom, youngest on top. But in some valleys blocks of strata had been tilted, folded, thrust upward and down-dropped; they were the geologic by-products of the same plate tectonic forces that had carved the Rift. In other areas, strata were difficult to trace because of intervening patches of covered terrain. In these instances the matching of sequences of rock layers from one area to another would depend, to some extent, on matching the faunas preserved in each of the rock units—faunal correlation—as well as on the dating of the ash beds. One of the ash layers, called the cindery tuff, could be traced for miles across much of the Middle Awash and was an outstanding geologic marker bed. It would prove even more important later.

One of the badland valleys in the Maka area was a veritable graveyard of Pliocene mammals. Here, in the late afternoon, near the end of November, Tim White found part of a Pliocene hominid—the upper part of a femur, or thigh bone—amid the bony debris of other animals. Its shape was distinctive. Tim had worked with Don Johanson on the hominid material from Hadar and Laetoli, which they had placed in a new species, *Australopithecus afarensis*, and to which “Lucy” belonged. The femur preserved the head, or ball, which fits into the socket of the pelvis, and White was sure that, like “Lucy’s” femur, it belonged to a small hominid that had walked erect. The femur had eroded out of rocks that were just above, and thus slightly younger than, the cindery tuff. It was all that remained of this individual. The rest of the skeleton either had eroded out earlier and washed away or had never been preserved intact.

A week later, in a second set of badlands, we found a second hominid, this time in sediments below (and older than) the cindery tuff. I had come across the skull of a fossil pig at the base of a small knoll and, moments later, was fortunate to spot two pieces of a hominid skull lying nearby. The fragments fit together

and preserved part of the bony region above the right eye and temple. Tim and I dug through the underlying sand and recovered four more pieces of the same skull. A fifth was found later, when the top layer of sediment near the knoll was sieved through screens. The skull bones were thick and, like the femur, seemed to bear the telltale anatomical signs of a small, primitive hominid. The fossil faunas, especially the species of pigs, from the hominid-bearing rocks above and below the cindery tuff gave us an approximate indication of the age of the femur and skull bones: older than three million years. Lab tests of the tuff would give a more precise date.

We broke camp three days later and left the Middle Awash. Tim returned to Berkeley with the borrowed hominid material to carry out a detailed analysis of the anatomy of the preserved portions of the femur and skull and to compare them with “Lucy” and other remains of early man. Bob Walter, laden with samples of the cindery tuff and the other ash

beds, returned to the University of Toronto to begin the long and painstaking process of dating the tuffs. Three months later the first results were in. The femur and skull bones belonged unquestionably to a primitive, *Australopithecus afarensis*-like hominid. The anatomy of the thigh bone indicated that its bearer was fully bipedal and walked upright. The skull bones, more of which were found to fit together, had housed a small brain, about the size of that of a chimpanzee. The cranium of *A. afarensis* had never been recovered, but these skull fragments from the Middle Awash corresponded in size and shape to what Johanson and White had reconstructed for that species. And, lastly, the hominid bones were much older than we had suspected in the field. Bob Walter had dated the cindery tuff at 4 million years in a series of independent tests. That meant that the femur, from above the tuff, was slightly younger, and the skull bones, from below the ash bed, slightly older than 4 million. These were the oldest



Above: Bob Walter holds a nest of petrified Pliocene crocodile eggs found in the Maka area of the Middle Awash.



Left: one of the fossil eggs close up.



Tim White holds the partial femur of a hominid that he found in Pliocene rocks in the Maka area of the Middle Awash, above the cindery tuff.

Center: The author (left) and Dr. White examine two pieces of a hominid skull, moments after they were found in Pliocene rocks below the 4 million year old cindery tuff in the Belohdelie area of the Middle Awash.

Bottom: The first two pieces of the skull fit together and composed part of the area above the right eye, temple and forehead. Five other pieces of the same skull also recovered are shown in the background.



known hominid remains, approximately half a million years older than *A. afarensis* from Hadar, which had been dated at about 3.6 million.

For Johanson and White, these results strengthened their contention that *A. afarensis* was the common evolutionary ancestor of two lineages of hominids: one comprised the later species of *Australopithecus*, the last of which became extinct about a million years ago; the other lineage contained the species of *Homo* and led to modern man. In this reconstruction, the major adaptations in the evolution of *Homo* from *A. afarensis* involved an increase in brain size, a decrease in the size of the canine teeth, and other modifications in the skull and dentition. But the definition and evolutionary position of *A. afarensis* are bones of contention in anthropology. The Johanson-White view of hominid evolution is not accepted by all paleoanthropologists, notably Richard and Mary Leakey, who claim that the ancestry of *Homo* is older than and does not involve *A. afarensis*. Others hold that the hominid material from Hadar and Laetoli represents two different species of early man. Yet others, like Phillip Tobias, interpret *Australopithecus afarensis* as a subspecies of *A. africanus*—a species best known from Pliocene cave breccias in South Africa. And, most recently, a geologist, Francis Brown, lowered the age of the oldest hominid remains from Hadar from 3.6 to 3.1 million years, after reanalyzing one of the volcanic tuffs from that area. Following suit, an anthropologist, Noel Boaz, argued that the recalibrated, younger age of the Hadar hominids was enough to question the ancestral status of *A. afarensis*.

These issues are now the subject of much debate in academic journals. The issues are not all of equal scientific merit. The evolutionary relationships among organisms, including hominids, are determined primarily from their morphology—their inherited physical features—rather than from their antiquity. In the long run, the resolution of these issues, as well as the determination of the pattern and course of human evolution, lie, in part, in the 4 million year old hominid bones from the Middle Awash and in older ones yet to be discovered in East Africa and elsewhere.

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Photographs are by Dr. Krishtalka, except as noted.

THE NATURE OF THE FREE LIVING GORILLA

by DIAN FOSSEY

Photographs by the author, except as noted. All photographs courtesy of the National Geographic Society.

Following the scientific discovery of the lowland gorilla (*Gorilla gorilla gorilla*) in West Africa in 1847, hordes of adventurers and hunters flocked to the coastal region of the little-known continent drawn by curiosity, greed, and, in a few instances, scientific interest. Among the most flamboyant of these early travelers was one Paul Du Chaillu who claimed the dubious honor of having been the first white man ever to kill a gorilla.

Du Chaillu's descriptions of the great ape as a horror monster captivated the imagination of a gullible public:

It stood about a dozen yards from us and was a sight I shall never forget. Nearly six feet high, with immense body, huge chest, and great muscular arms, with fiercely glaring, large, deep grey eyes, and and hellish expression of face, which seemed to me some nightmare vision; there stood before us the king of the African forest. He was not afraid of us. He stood there and beat his breast with his large fists till it resounded like an immense bass drum, which is their mode of bidding defiance; sometimes giving vent to roar after roar... His eyes began to flash fiercer fire as we stood motionless on the defense, and the crest of short hair which stands on his forehead began to twitch rapidly up and down, while his powerful fangs were shown as he again sent forth a thunderous roar, and now truly he reminded me of nothing but some hellish dream-creature.

This unsavory image endured until the beginning of the 20th century when the mountain gorilla (*Gorilla gorilla beringei*) became first known to the Western World in 1902. Exactly as occurred following the discovery of the lowland gorilla, swarms of adventurers, now called "scientific collectors," flocked to the Virunga Mountains of central Africa.

Among them was Carl Akeley who sought to acquire a limited number of specimens for a panorama for the African

Hall of Mammals at the American Museum of Natural History. Akeley was a different breed of man from Du Chaillu. Given a permit to collect ten specimens by the Belgian government, Akeley sensed the rarity of the subspecies and stopped after the fifth was killed. His remorse was deep. Later he wrote:

As he lay at the base of the tree, it took all one's scientific ardor to keep from feeling like a murderer. He was a magnificent creature with the face of an amiable giant who would do no harm except perhaps in self-defense or in defense of his friends.

And so, finally, was the true nature of the gorilla revealed, but only to become marred by mankind's need to have a scapegoat image of his own worse side.

Carl Akeley was a man ahead of his time in realizing that extinction is forever. He convinced the King of Belgium to establish a national park encompassing three of the majestic Virunga Volcanoes. The area soon became an international park when the remainder of the mountains were incorporated giving the legacy of the mountain gorillas' survival to the countries of Zaire, Uganda and Rwanda. Sadly, before this monument to Akeley's foresight became official, at least 54 more gorillas were collected from the Virunga Volcanoes to satisfy scientific curiosity about their physiological characteristics.

As interesting and at times even controversial as were the findings gleaned by the anatomists from their specimens, virtually nothing was known about the behavior or the nature of the mountain gorilla in the wild until George Schaller's pioneering field study in 1959–60. In total accord with Akeley, Schaller described gorillas as gentle, dignified animals living in relatively cohesive familial groups.

The chestbeat, which Du Chaillu explained as "beating his breast in rage," was thoroughly analyzed by Schaller, who termed the activity sequence as "one of the most ritualized displays

among mammals." He likened the action to that of a human who, when in conflicting situations, may throw objects, slam doors or stamp his feet. By their respective, innate behavior, the tensions of both gorilla and man may be resolved without the obligations of either direct attack or retreat. How sadly ironic it is that the upright position assumed by a chestbeating gorilla when confronted by threat exposes his most vulnerable body surface to the source of danger, be it a human's weapon or, indeed, another gorilla.

Other than human beings, gorillas have no enemies. Intraspecific aggression occurs rarely. To understand the provocation for same, one must understand the nature of the animals' social organization. Mountain gorillas live in fairly stable family groups averaging ten members. Each group contains at least one silverback, a sexually mature male over fifteen years in age; usually one or two blackbacks, sexually immature males between eight to twelve years in age; three to six adult females over eight years in age; and some four to six immatures who have been bred within the group. No gorilla group can exist as an integral unit without its silverback leader who is dominant over all group members and who has almost complete priority of breeding access to females whom he acquired from other groups during the formation of his own harem.

Upon approaching sexual maturity males will usually leave their natal groups if no potential breeding opportunities are available, or if a second male peer resident is more closely related to the dominant silverback. The emigrant male spends several years in lone travel to gain familiarity with other range areas and to obtain experience in interactions with other groups containing females. Like young males, sexually maturing females usually also leave their natal groups if no breeding opportunities are available but, unlike males, females rarely travel alone. They transfer directly either to a lone silverback seeking mates or to another group's silverback who is expanding his harem. This

process of group formation or group expansion is a logical one that assures exogamy, or outbreeding, and it is usually only during these interactions between silverbacks of two different units that aggression may occur.

No adults have ever been known to kill one another during interactions; however wounding does occur, as does infanticide, the deliberate killing of infants. Among gorillas, infanticide is a reproductive strategy in which the infanticidal male, by expediently disposing of a female's dependent infant, accelerates the mother's return to estrus enabling the male to breed with her himself. Because nonresident or extraneous silverbacks are not allowed breeding access to a group's females, the death of the infant usually prompts the victim's mother to leave her group and form new bonds with the infanticidal male. Thus, a new breeding pair and, often, the foundations of a new group are established.

When one considers the physical endowments of the silverback and the high degree of sexual dimorphism in the species, it is tempting to characterize the nature of the beast as that of a veritable King Kong. To quite the contrary, the massive silverbacks, as though aware of the tremendous strength they possess, have evolved remarkable repertoires of "parallel displays" that enable them to avoid overt combat yet advertise, if not embellish, their physical prowess to one another. Adult males may rigidly strut in a stiff-legged manner parallel to each other and with heads slightly averted to give the impression that they are not

watching the other's movements. The impressiveness of the deliberate pacing is magnified by long, flowing arm hair, increased visibility of silvered saddles, and erected head hair atop prominent sagittal crests. Whenever tension between displayers appears to become unbearable, it may be released by separating runs terminated by harmless but loud chestbeating, branch breaking or foliage whacking. Such ritualized silverback sparring is most effective as a means of visual and auditory intimidation that avoids physical confrontation.

The imposing spectacle of the silverback enacting his role as family defender is in marked contrast to the benignancy so characteristic of a male's paternal role. The polygamous social organization of gorillas mandates a near constant proximity of father, often grandfather, to both mates and offspring, a situation unique among hominoids. There is a tendency to anthropomorphize, particularly when the observational subject is one of our closest living relatives. Because of our similarity of body languages and facial expressions, it is almost impossible not to ascribe an aura of complacent togetherness among the multigenerational members of a gorilla group as they go about their daily activities in an undisturbed manner.

During prolonged day-resting periods, female and young alike are magnetized toward the dominant silverback whose tolerance and consistent behavior are but two of the hallmarks responsible for his success as a group leader. The silverback does exhibit a slight degree of partiality toward the more dominant females of his harem—those whom he first acquired and with whom he has had the longest bonding association. Mem-

bers of a silverback's harem seem aware of their status within the female hierarchy and rarely evoke squabbles among themselves unless entering their estrus periods.

Between three to five days each month pubescent female gorillas become coquettishly flirtatious with the young males of their group. In turn, the young males react by strutting and swaggering in somewhat comical imitations of their elders. The presence of an estrous female results in a number of vicarious mountings between individuals of the same sex or between unrelated adults and immatures. Such disparate mountings appear to be a learning process contributing toward sexual experience before the ultimate, serious breeding type of mountings begin. Females with infants under two years of age seldom show any signs of sexual receptivity until their offspring are being intensively weaned during the end of their second year; however when they do re-enter estrus, they seem to have no qualms about flaunting their favors to solicit copulations with their group's leader. The ever dependable silverback mates with the family's grandmothers and mothers with near-equal intensity but never with his own daughters, who only mate with the group's younger males.

Some friction, not unlike jealousy, occurs between matrilineal clans during the days a female is in estrus as the members of the dominant clan temporarily lose their status to the receptive female and members of her clan. The resultant squabbles consist primarily of shrieks and grunts between females seeking priority placement near the dominant silverback who easily settles disputes by either disciplinary vocaliza-

*"His powerful fangs were shown as he again sent forth a thunderous roar" (Du Chaillu, 1861).
"A young silverback yawning" (Fossey, 1977).*

"He was a magnificent creature with the face of an amiable giant" (Akeley, 1921). "A silverback group leader, his mate and their infant" (Fossey, 1969).



Bob Campbell

tions, direct glares or runs into the midst of the unruly females. If intense, the quarrels may be heard for nearly a mile in the forest and draw the attention of any lone males who happen to be within auditory distance of the group. Such vocal advertisement prompts an increase in interactions, particularly if the receptive female is a younger individual destined to emigrate from her group to acquire breeding opportunities elsewhere.

Intragroup unrest may also occur when a family descends en masse to a limited choice food site such as a stand of delectable, ripe wild blackberries, small stands of newly shooting bamboo, the occasional growths of parasitical bracket fungus (*Ganoderma applanatum*) on trees, or vines of the mistletoe family (*Loranthus luteo-aurantiacus*). Dominant silverbacks tend to pull rank at these restricted feeding locations, but once they have satisfied their needs, their family members have the right of access to the choice food resource. On occasions such as these, the presence of a female dominance hierarchy functions well as an innate dispenser of rights among members of matrilineal clans. Adults appear to know their places, and the immatures learn by trial and error of their position within their natal group.

It is because of the cohesiveness of the small gorilla family group that immatures are able to form relatively stable and even long-term associations with their peers, siblings, parents and often, grandparents. The prolonged period of dependency upon their mothers, much like that of human children, provides the gorilla young with multiple learning opportunities and enables them to cope not only with the demands of their environment but, equally as important, with their conspecifics.

Individual variations in behavior become most obvious in maternal care. The permissiveness of one mother may be in marked contrast to the strictness of a second even though both reside in the same group and share the same silverback. Basic reasons for the differences appear to be related to having had the opportunities to practice maternal care with younger siblings and also reflect the degree of security the young female received during her formative years.

Low-ranking females bearing offspring in large established groups do not make effective mothers. Because of their own instability, they are not consistent in their treatment of offspring. The situation, however, is revokable, for these are the mothers who emigrate to either smaller groups or to lone males, a step that vastly improves their rank as well as that of subsequent offspring. Should they migrate when their infant is still

dependent upon them, infanticide will occur. Should they have a weaned offspring, it will be left behind in its natal group where it will be cared for by the group's dominant silverback.

The silverback, in addition to all of his other responsibilities, has amazing paternal capacities. These become most evident when the need arises to "adopt" a youngster who has lost its mother through either death or emigration. With great zealotry the male safeguards the maternally deprived individual from rowdy playmates or inquisitive adult group members. To the best of his ability

the great male conscientiously grooms his charge and nightnests with it far longer than mothers nightnest with their own offspring. Although verging on being "spoiled," the orphaned immature raised by the group's silverback develops into an extremely well-adjusted adult and, if a female, into a surprisingly responsible mother despite the deprivation of its own mother during vulnerable years.

Do orphans grieve following the loss of one or both parents? The answer de-

SPECIAL LECTURE BY DIAN FOSSEY



Dr. Dian Fossey will present an illustrated program entitled "Mountain Gorilla: Gentle Giant of the Forest" at the Natural History Museum. Dr. Fossey is the author of a new book, *Gorillas in the Mist*, and is best known for her work at the Karisoke Research Centre, which she established in 1967 in the Virunga Volcanoes of Africa. She has developed a unique approach to primate study, spending months in the wild with her gorilla subjects and earning their confidence by imitating their behavior, body language, vocalizations and feeding habits. Her work has contributed much of what we now know concerning the imperiled gorilla species.

Dr. Fossey's lecture is cosponsored by the L.S.B. Leakey Foundation and is part of the Museum's fall evening program series, Passage to Africa. She will speak on Saturday, September 24th, at 8 p.m. in the Jean Delacour Auditorium of the Natural History Museum; her talk will be followed by a reception and book-signing session.

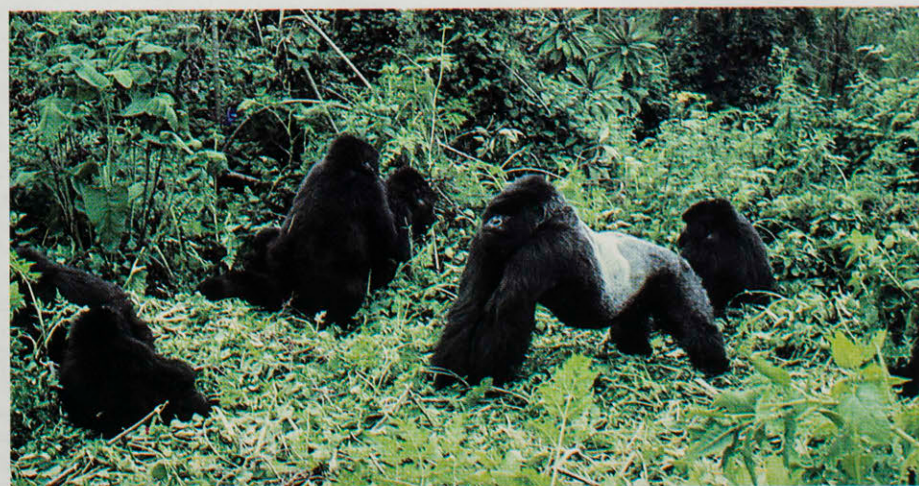
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The Virunga Volcanoes: six dormant volcanoes shared by the countries of Zaire, Rwanda and Uganda and totaling 375 sq km (about 150 sq miles) remain the last stronghold for the mountain gorilla.

Tension between silverbacks is released with runs terminated by harmless but loud chestbeating, branch breaking or foliage whacking.

Alan Root



Above: A calm benignancy is characteristic of a male's paternal role.

Center left: "Beating his breast in rage" (Du Chaillu, 1861). "One of the most ritualized displays among mammals" (Schaller, 1963). "An adult chestbeats in alarm at observers" (Fossey, 1968).

Bottom left: No gorilla group can exist as an integral unit without its silverback leader.

The permissiveness of one mother may be in marked contrast to the strictness of a second.



When the silverback adopts a motherless youngster, he nightnests with it far longer than mothers nightnest with their own offspring.

depends upon the nature of the loss; was it extended over time such as might occur with an adult incapacitated by disease, or was it a sudden loss such as one brought about by emigration or slaying by poachers? It appears that immatures who lose a parent following a period of prolonged illness are better able to adjust because of the intrinsic nature of their family group. An individual, regardless of age or sex, weakened by disease or accidental causes is never shunned or neglected by its family members. The group members, under the direction and leadership of the dominant silverback, alter their pace of travel to enable the infirmed individual to keep up with them while the male leader endeavors to protect it against expressions of curiosity from others of the group. The degree of intention or conscious concern with which the animals are reacting to the situation is impossible for human beings to realize. It may only be stated with certainty that a young animal undergoing the throes of losing a parent becomes more self-reliant while simultaneously being supported by increasing amounts of affiliative attention from peers and siblings, if any, within its group.

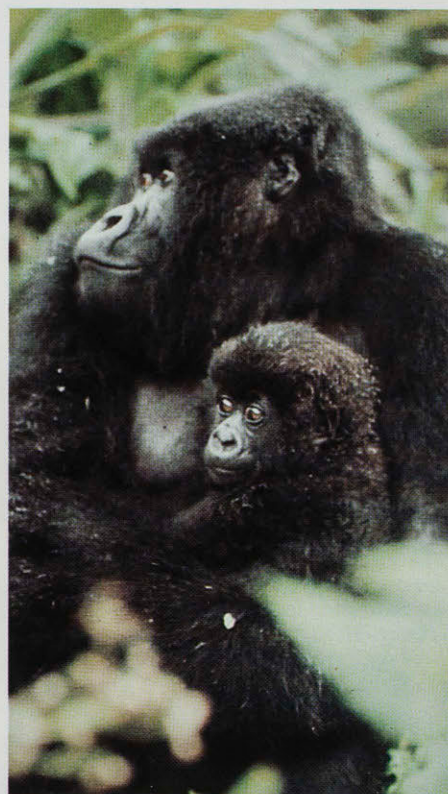
On the other hand, sudden deprivation of a parent figure leaves the gorilla youngster totally unprepared. Its most immediate reaction is to withdraw from all play activity before refraining from

the usual prolonged feeding bouts which, in turn, results in increased coprophagy (eating of its own excrement). The substitution of the silverback as a maternal figure inevitably returns the young individual to normalcy.

The most severe effects of deprivation of either or both parents occur following trauma, particularly poacher slayings. Such incidences result in long-term depressive repercussions, which are not only apparent in orphaned individuals but also in other group members who have managed to survive poacher raids. The ability of the older animals to give protectively of themselves toward younger group members may still be manifested, but it seems reduced perhaps because of innate apprehensions over extraneous influences against which the species has no control.

For the gorilla mother, the loss of an infant imposes no apparent signs of distress, particularly after infanticide. Quite contrarily, primiparous mothers resort to juvenile-like play behavior following the loss of their first-born to infanticide. Perhaps such unexpected reactions reflect upon the young mother's relief at being unburdened by her first, though short-lived maternal responsibility, or possibly playful behavior is a means by which the mother attempts to reinforce affiliative bonds with group members following the trauma of the infanticidal incident.

Low-ranking females do not make effective mothers and tend to reflect their instability upon their offspring.



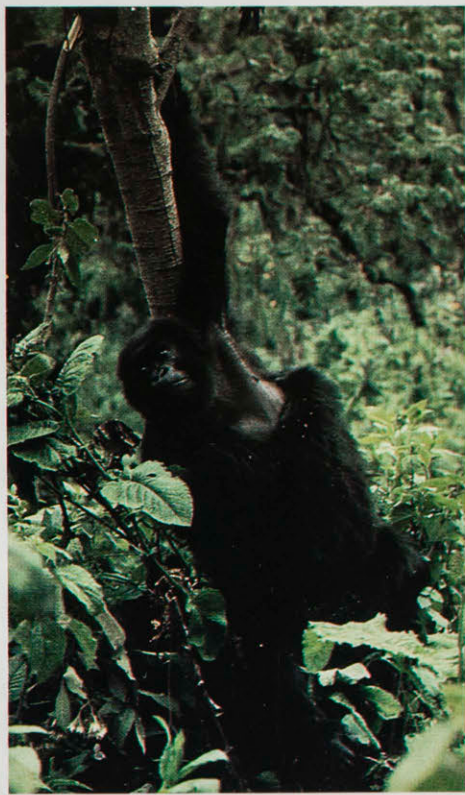
Another human-like emotion infrequently observed in free-living gorillas is anger. Temper appears to be motivated by frustration among young gorillas and is seen in its purest form in the temper tantrums of infants undergoing intensive weaning. Soft whines may build up into loud shrieks when the mother refuses to allow her infant to suckle. Should the baby continue shrieking, it is more likely to receive a gruff disciplinary vocalization from its mother rather than access to her breast. On the other hand, if an infant is temporarily separated from its mother during travel and its cries escalate into temper shrieks, the mother instantly runs back to pacify the child and the incident is immediately forgotten.

The most commonly heard gorilla vocalization is a soft, rumbling, highly gradated sound subjectively described as the 'belch vocalization.' The sound, heard from all age-sex classes, serves as a contact maintenance signal denoting the position of one individual to another when all are obscured in dense vegetation. It also conveys a sense of contentment between group members as well as a greeting signal. A slightly shortened version of the belch vocalization given by adults may serve as a mild rebuke to restrain rowdily playing young, but the most common disciplinary vocalization is the 'pig grunt,' a series of short, guttural sounds resembling those heard

The presence of an estrous female results in a number of vicarious mountings between individuals of the same sex or between unrelated adults and immatures.



Primiparous mothers resort to juvenile-like play behavior following the loss of their first-born through infanticide.



from pigs feeding at a sty. These may be exchanged between adults during minor feeding disputes or 'right of way' squabbles along trails or at nesting locations. There seems to be a contagious spread among adults once the vocalizations begin so that an intragroup quarrel carries for as far as a mile. However, only a few grunts need to be directed toward misbehaving youngsters before being heeded.

Obedience rather than impertinence is the predominant behavioral trait that characterizes immature gorillas. This is undoubtedly the case because of long-term living in close, multigenerational family units. The young are provided with daily input of information concerning the moods of their elders and peers. Typical of the nature of any family structure, there are times when the father or grandfather figures may be irascible for reasons varying from simple toothaches to interactions with other groups, or the matriline may be quarreling among themselves for physiological, female reasons. Overall, it is the consistency rather than the inconsistency of gorilla group life that contributes toward learning experiences during the animals' formative years.

The senses of right and wrong are ingrained at an early age. If a young gorilla feels that it has been disciplined unjustly because of the transgressions of

an even younger group member, it will resort, much as a human child, to sulking. Prolonged pouts are a visual expression of "I didn't do it" discontent and are often accompanied by sublimated actions such as foot stomping or foliage whacking and, on one occasion, masturbation.

A young female was denied access to the observer's camera (cameras, lenses, and binoculars are frequently purloined objects, which adolescent gorillas covet in order to obtain their reflections in the glass). Fretfully, the animal made a day nest and glared at the observer for a two-hour period while the remainder of the group dozed contentedly. Finally when the family arose to move off, the female gave vent to her grudge by standing bipedally and whacking the human full force on the back several times.

The sound alerted the group's dominant silverback who, with a stern facial expression and harsh pig grunts, ran directly to the female, not the observer, and glared at her until she retreated submissively downhill. There she sat and masturbated for nearly five minutes before running off to rejoin her group. Similar behavior has never been seen before or since among free-living gorillas.

The animals' fascination with their own images discovered in camera lenses is of particular interest because they have never reacted in a hostile manner toward this "other self" staring back at

them. The only means by which free-living gorilla might have seen reflections of themselves, prior to the intrusion of the camera into their lives, would have occurred upon encountering still pools of water within their habitat, and they have been seen staring into these. Occasionally a small hand mirror was taken out to a group. It was ignored by the adults and seemed to represent a threat to the same infants and young juveniles who had readily accepted their reflections in a camera lens. The adolescents, those around seven years of age, were immediately attracted to the mirror and, after only several groping gestures behind it, would sit for fifteen minutes at a time gazing at their reflections wearing relaxed and slightly smiling expressions.

Among free-living gorillas, curiosity seems to be provoked only when inquisitiveness provides a stimulating response. For example, a herd of twenty odd buffalo grazing in a nearby meadow seldom seems to be of interest to a gorilla group, but should a solitary buffalo be encountered along a narrow trail, silverbacks will chase it off in what appears to be a playful manner. Bird nests containing live fledglings are, strangely enough, ignored by passing gorillas but, once the same nests have been abandoned, they become play objects to be torn apart, beat against the chests, or stuffed into the seats of day nests. Even ordinary flies are ignored or whisked off unless buzzing

During prolonged resting periods, female and young alike are magnetized toward the dominant silverback.



The young animal made a daynest and glared at the observer for 2 hours. Finally, she gave vent to her grudge by standing and whacking the human full force on the back several times.



Cameras, lenses and binoculars are frequently purloined objects, which adolescent gorillas covet in order to obtain their reflections in the glass.

around young gorillas apparently bored during prolonged day resting periods. At such times a single fly may provide several minutes of entertainment after being painstakingly trapped in the gorilla's hands and slowly examined piece by piece.

Probably one of the most interesting aspects of the nature of a gorilla is the dignity and fortitude with which he copes with the human encroachment of his environment. The Virunga mountains have been plagued by cattle grazers, scientific collectors, poachers, cultivators, and tourists. Only 375 sq km (about 150 sq miles) remain of the original 500 sq km set aside for the protection of the parklands. Only some 240 mountain gorillas remain within an isle surrounded by seas of cultivation. This last stronghold for survival of the imperiled gorilla subspecies is as much an oasis for them as it is for the throngs of Africans (800 humans per square mile adjacent to the park boundaries in Rwanda) trying to eke out their own survival on minuscule farm allotments. These people look up toward the mountains not as you, I, or Carl Akeley, but more as men dying of thirst on a desert might regard an oasis as hope.

Western world wildlife conservation efforts are virtually functionless when they become idealized to the extent that

their conceptualized goals represent little value to Third World citizens. Direct, daily and active conservation efforts, of necessity, must replace or at least precede theoretical conservation promises. The former consists of vigilantly cutting illegal traps, antipoacher patrols, confiscation of poacher weapons and prolonged, enforced imprisonment of all encroachers found within the park. The latter, aimed primarily toward expansion of tourism, undoubtedly has strong merits but is a goal that should be held for "tomorrow." The mountain gorillas are running out of "todays."

Dr. Dian Fossey is the founder of the Karisoke Research Centre in Rwanda, Africa. Her field work was launched in 1967 by the late Dr. L. S. B. Leakey; Dr. Leakey and the National Geographic Society have generously supported the camp from that time and into the present, 1983.

In 1976 Dr. Fossey obtained her doctorate in Zoology at the University of Cambridge, England, under the supervision of Dr. R. A. Hinde and with a grant made possible by the Wenner-Gren Foundation. In March 1980, following thirteen years of field work, Dr. Fossey was given a one-year position at Cornell University as a Visiting Associate Professor. She will be returning to Africa for further work with gorillas in 1983.



David Gamble, Consul General of New Zealand for Los Angeles (left) and Richard Sewell, Vice Consul, present twenty-three books on the natural history and ethnology of New Zealand to Katharine Donahue and Kathryn Showers, Librarians of the Natural History Museum's Research Library. Donated by the Government of New Zealand as part of its information and publicity program, the books include a twelve-volume set on the Maori by Elsdon Best and Beaglehole's life of Captain Cook, as well as other botanical and zoological works. The gift, a valuable addition to the Library's collections, was donated in recognition of the Museum's considerable help in preparing for the upcoming exhibit *Tangata: The Maori Vision of Mankind*.

(Continued from page 2)

issue highlights the current displays and continuing research activities at the Museums. The magazine gives Members an armchair, in-depth view of exhibits and programs as well as priority notice of special events.

Your membership benefits—privileged access to two great museums and their treasures—are increasing as the frequency of *TERRA*, your Museum "display by mail," increases.

Gretchen Sibley Receives Award

Gretchen Sibley, Museum Education Specialist Emeritus, has won another award for her work at the Museum. On Sunday, May 22, she was presented with an award for "distinguished career and professional service" by Delta Kappa Gamma, an international organization for outstanding women educators. Miss Sibley was chosen from among 10,000 women in California as recipient of the

first such award given by the society.

Miss Sibley was recognized for her work at the Museum, particularly in three areas. For thirty years she directed the Museum's continuing program, Natural Science Workshop, which during her tenure provided special training to over 3,500 high school students. In 1952 she established the Southern California Science Fair, the first west of the Mississippi; the fair was held at the Museum for ten years before becoming a program of the Los Angeles Unified School District. The third project, the Museum Docent Program begun in 1962, was directed by Miss Sibley for thirteen years before her retirement.

Malacology Section Receives Grant

The excellence of the Museum's Malacology collection has been recognized by the National Science Foundation through the award of a grant totaling

\$260,000 to be used over a three-year period for curatorial upgrading that will make it an even more valuable research resource. The marine mollusk collection at the Natural History Museum is now the largest existing of eastern Pacific shells, having large series of specimens of most species that occur in the area between Alaska and Chile.

Dr. James H. McLean, Curator of Malacology, will oversee the work of two additional staff members, a laboratory technician and a collection manager. Under the terms of the grant, curation of specimens obtained on field expeditions in recent years will be completed, and the entire collection will be computerized, using the minicomputer of the Life Sciences Division. Computerization will enable retrieval of information about the entire molluscan fauna of the Pacific coast. Other improvements for the Malacology Section include a doubling of office and laboratory space and the addition of 60 new collection storage cabinets.

Ornithologists to Study El Niño

The disappearance of tropical seabirds of Christmas Island, Central Pacific Ocean, was documented in November 1982 by Dr. Ralph W. Schreiber, Curator of Ornithology, and his wife and fellow ornithologist, Elizabeth Anne Schreiber (see *TERRA*, Winter 1982, p. 2). The birds' disappearance turned out to forewarn a major shift in atmospheric and oceanic conditions that scientists call the Southern Oscillation (popularly known as El Niño).

Considerable national and international press coverage has been given to the anomalous weather during the past six months. The Schreibers have now received research grants from the National Science Foundation and the National Geographic Society to document the return of the birds to Christmas Island during the coming year. Those funds will allow the ornithologists to carefully study when and if the birds return to nest, in what numbers they return, their diet during this time, their reproductive success, and the timing of nesting cycles upon their return.

The Christmas Island study is unique in marine ornithology, and the Schreibers are fortunate to have the background data from privately supported expeditions to the island over the past four years to use as a basis for continuing studies. The two major points they have learned from the El Niño situation are the necessity for long-term (10 to 15 year) studies in ecology and population research and the need for a global view. The weather patterns that affected Christmas Island and the California coast this winter have had worldwide ramifications, not only for the seabird populations but for all of us.

Dr. Schreiber was elected President of the Cooper Ornithological Society in May 1983, at the society's annual meeting in Albuquerque, New Mexico. The COS has 2,200 members worldwide and publishes a quarterly journal *The Condor* and an occasional series *Studies in Avian Biology*. Dr. Schreiber has served on the Board of Directors for the past 3 years; Elizabeth Anne has served as Secretary of the organization for the past year and will continue in that position.

Schreiber's election has historical significance to the Natural History Museum because one of the founding organizations of the Museum was the Southern Division of the Cooper Ornithological Club, and the Museum's first director was Frank S. Daggett (director from 1911 to 1920), who also served as President of the Cooper Ornithological Club from 1901 to 1903.

Robert E. Wade 1920–1983

Robert Edward Wade, retired Chief of the Natural History Museum's Exhibitions Division, died in Los Angeles on April 6, 1983, after a brief illness.

A native Californian (born in Hollywood), Mr. Wade received his formal training in Interior and Industrial Design from Art Center School. After completing his studies, he served as a Technical Illustrator for Douglas Aircraft Co., followed by a tour of duty as Illustrator and Training Aid Designer for the U.S. Navy during World War II. In 1947, he began working at the Natural History Museum. Mr. Wade progressed rapidly up the ranks from Preparator to Chief of the Exhibitions Division, a position he held until retirement in 1978.

Upon retirement and with the aid of the Retired Senior Volunteer Program, he accepted the challenge to design and build the exhibits of the newly created (1980) Torrance Historical Society Museum. He remained as that institution's Exhibits Director until his death.

During his active career, Mr. Wade was enlisted as designer and consultant to twenty-one different museums and nature centers. As a hobby, he enjoyed acquiring, studying and writing about spinning tops; his collection of 1,500 of these toys is one of the largest and most unusual in existence.

Robert Wade's enthusiasm and dedication to his work are evident in the excellent permanent exhibits mounted by the Natural History Museum during his tenure.



Robert E. Wade, Chief of the Natural History Museum's Exhibitions Division from 1956 to 1978.

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FOR

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Marge Hohly

BAJA CALIFORNIA WHALE WATCHING TRIP

February 11 to 18, 1984—\$900

Dr. Larry Barnes and Dr. Gary Wallace, Museum Curators, will lead the Museum's annual whale watching trip to Baja California. The focus of this week-long trip is the natural history of the offshore islands between San Diego and San Ignacio Lagoon. The trip's highlight is the chance to observe gray whale behavior at close range including mating, breaching and cow/calf interaction.

YUCATAN STUDY TOUR

April 6 to 22, 1984—\$1,610.00 (plus about \$350 airfare).

The Natural History Museum Alliance is pleased to offer a spectacular trip to the famous Mayan sites of the Yucatan Peninsula. Highlights of this 17-day journey include stops at Uxmal, Chichen-Itza, Palenque and Coba as well as many of the fascinating ruins off the "beaten track."



Tom Peirce



Tom Peirce

EAST AFRICAN SAFARI

January 19 to February 4, 1984—\$3,875.00 (airfare included).

Join Dr. John Harris, Chief Curator of Earth Sciences, on a safari to East Africa. Before joining the staff of the Natural History Museum, Dr. Harris was

Director of Paleontology at the National Museums of Kenya for over 8 years. His familiarity with East Africa will enhance this adventure, which will include

stops at Olduvai Gorge, Mount Meru, Manyara, Ngorongoro Crater and, of course, the Serengeti!



Explorers World Travel



Explorers World Travel

For information about these trips and others offered by the Natural History Museum Alliance, use the coupon in the center of this issue of TERRA or call Judy Astone at **213/744-3426**.

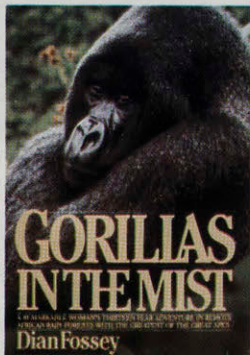
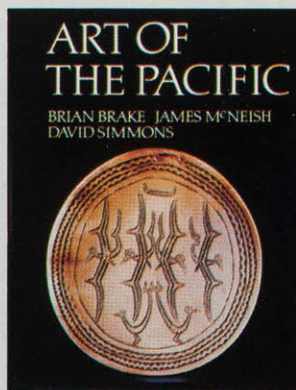
IN THE NATURAL HISTORY MUSEUM BOOK SHOP...

Art of the Pacific

Photographs by Brian Brake
Commentary by David Simmons and
James McNeish

In 1974, Brian Brake was commissioned by the Queen Elizabeth II Arts Council of New Zealand to photograph some of the treasures of Maori, Polynesian and Melanesian art in the country's museums. The result is a beautiful book, with more than 180 photographs taken over a five-year period and a text that describes the materials, social meaning and use of each item. \$19.95

Brian Brake will be the guest speaker at the Members' Annual Luncheon on September 19, 1983.



Gorillas in the Mist

By Dr. Dian Fossey

GORILLAS IN THE MIST, by world-famous primatologist Dr. Dian Fossey, is one of the great personal and scientific adventure stories of our times. Dr. Fossey has spent thirteen years enduring the rigors of the remote African rain forests to study the greatest of the great apes, the mountain gorilla. This landmark book traces three generations of this rare and endangered species and in the process gives an intimate and endearing portrait of these "gentle giants." \$19.95.

Dr. Fossey will be present to lecture and autograph copies of her book in the Jean Delacour Auditorium of the Natural History Museum on Saturday evening, September 24, 1983, at 8:00 p.m.

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